THE Chemical Age

VOL. LXXII 19 MARCH 1955 No. 1862

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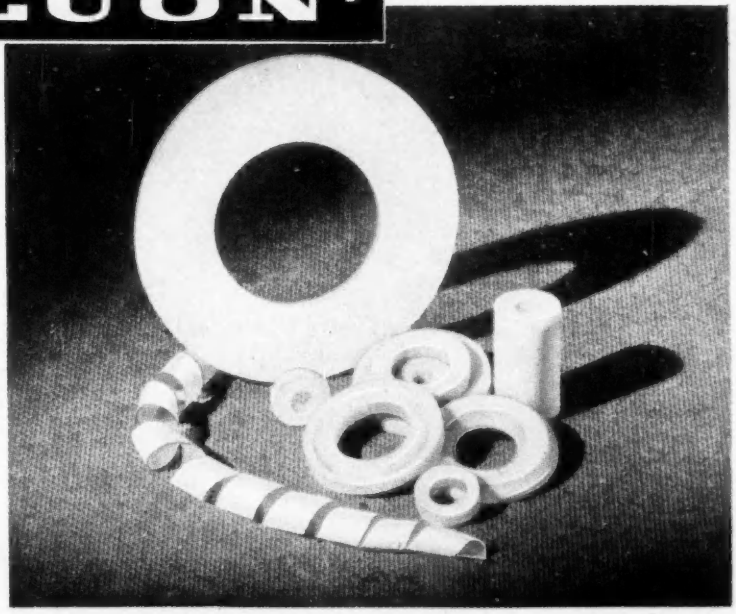

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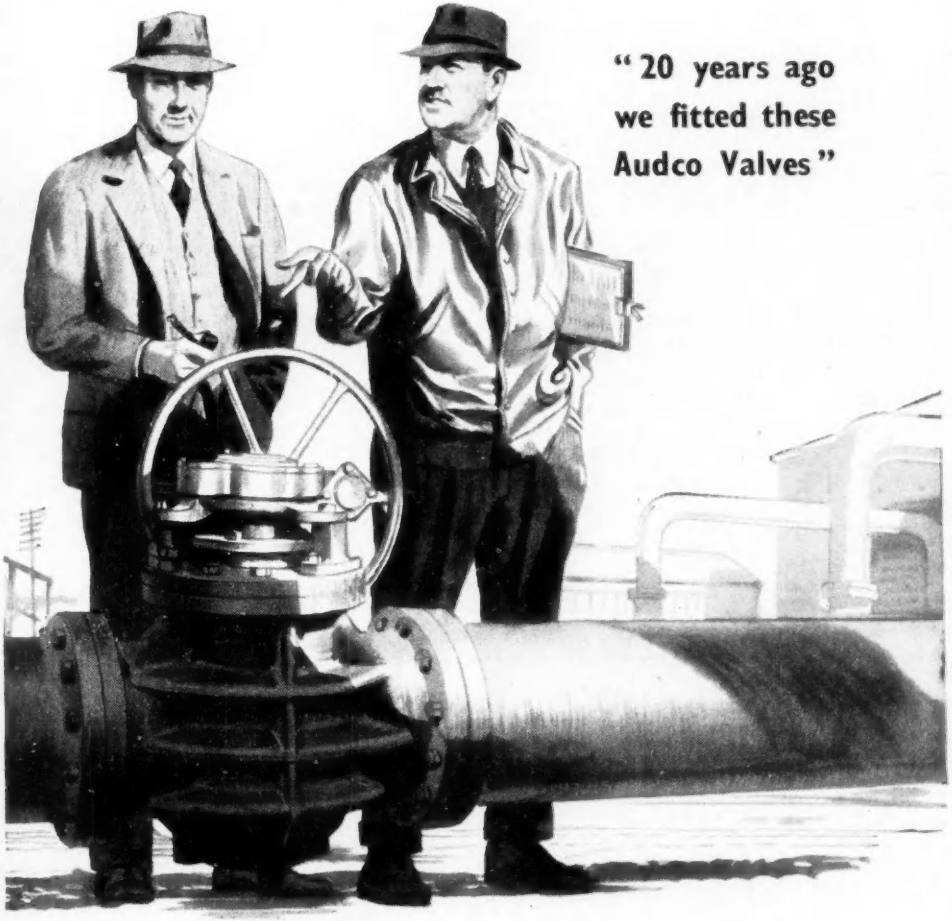

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Photochemistry

IT is easy to form the impression that photochemistry is a neglected subject. Although a great amount of work has been done in this century studying the effect of light upon reactions, specialists seem to have been particularly diffident about occasional surveys or reviews. Recently *Chemical Engineering* (1955, **62**, [2], 159) gave what was claimed to be the first published discussion of 'photochemical engineering' but in trying to collect information about industrial use of photochemical reactions, the compilers came up against trade secrecy. It seems clear that photochemical activation as a means of increasing reaction rates or controlling the course of a reaction is utilised to a greater extent than is widely known.

The effect of light upon chemicals seems with some irony to be traditionally unilluminated. When a few months ago Dr. Kenneth Mees, the English-born research director of Eastman Kodak, received the Franklin Medal, he explained how in the early years of this century he and another fellow-student of University College, London, could find no satisfactory explanation of the photographic process in any of the chemical text-books. When eventually they unearthed a classic paper of 1890, they saw the chance for improving upon this earlier work. The great Ramsay gave them full support and in the course of about six years many papers were published by these two students.

Most of us accept photochemistry as other people's field of specialisation. The now highly advanced field of photography itself is interesting enough on those occasions when scientists of the photographic industry tell us what they are achieving. We know that certain chemical changes are light-sensitive, that some reagents must be kept in dark-coloured bottles, that vitamin D is produced from its inactive precursor by irradiation with ultra-violet light, that the vitamin C in milk fades away as light falls upon the bottle on the doorstep. On the whole, we are inclined to regard these well-known cases of photochemical change as isolated phenomena, thus rejecting photochemistry as a practical subject of general potentiality. It is possible to give photochemistry a very broad definition so that it includes the effects of all forms of electromagnetic radiation upon chemical change. But in theory it is light radiation, visible or invisible, which should exercise effects upon reaction initiation. Light emission is due to energy changes in the outermost electrons; and chemical reactions are also normally brought about by energy changes in these outer shells.

The development of industrial organic chemistry has provided more circumstances in which the effects of visible or invisible light can be of importance, and

reaction rates and yields are much more variable in organic than in inorganic reactions. Today the most common example of industrial photochemical activation is the halogenation of hydrocarbons. Ultra-violet light enables methane to be chlorinated at higher rates and at lower temperatures, and the chance of a dangerous side-reaction—carbon formation—is minimised. In the chlorination of toluene, irradiation ensures that side-chain substitution is dominant with scarcely any invasion of the benzene ring by chlorine—thus the ratio of actual to theoretical yield is raised by photochemical control. Light is a similarly vital influence in the production of the gamma-isomer of benzene hexachloride; this seems to be one of the particularly notable examples of photochemistry in industrial action.

Other substitutions can be stimulated or made to give better yields by the influence of ultra-violet light—hydrohalogenation, as in the conversion of propylene to the primary bromide; production of mercaptans by direct addition of hydrogen sulphide to olefines; and paraffin sulphochlorination by reaction with both sulphur dioxide and chlorine simultaneously. The polymerisation of unsaturated organic compounds can be initiated by ultra-violet irradiation, and there are some cases where this method of starting chain formation is preferable to using catalysts. A particularly interesting example of photochemical influence is the additional use of a dye to produce the light-effect; the oxidation of nicotine can be carried out with light in the presence of methylene blue. However, this is certainly far from unique—a paper of 1942 reported that if certain carbonyl compounds were present, light of much higher wave-lengths could be used effectively, although in the absence of such compounds only short wave-length radiation was photochemically effective.

The shorter the wave-length, the greater the radiation cost. We may well assume that this aspect of photochemistry has been developed in some of the undisclosed industrial applications. It would seem that at present ultra-violet light produced from mercury lamps is the major source of photochemical activation. The *Chemical Engineering* review points out that the proportion of sunlight which is in the ultra-violet region is very small; it is necessary to have some means of concentrating it. The economics of photochemical processes are not encouragingly simple. There is little or no published information about existing processes, and pilot plant costs are high. Operating costs include not only the cost of ultra-violet light from lamps of limited lifetime but maintenance costs of plants which must be substantially constructed in special glasses or quartz. At the present stage of development, it seems a fair enough judgment to say that a photochemical process will only be economic if (1) the same rate of reaction and yield cannot be attained by more normal methods, and (2) if the end-product has a high value in comparison with the costs of the initial materials.

Nevertheless, the basic chemical reactions of the natural world, those of plant growth and synthesis, are photochemical reactions. Our food depends upon these reactions; even our food won from the seas is based fundamentally upon the photosynthetic harnessing of energy by unicellular marine flora. This year it has been reported from the University of California that protoplasts have been isolated from plant life and that they have carried photosynthesis on when thus isolated. It is very clear that within recent months a great advance has been made in unravelling the obstinate mystery of plant photosynthesis. But is chlorophyll the sole agent which will enable light in the visible wave-length range—rather than ultra-violet light—to initiate reactions? If so, or even if the natural agent is chlorophyll-plus-X (whatever X may be), how far can such knowledge be converted into industrial photochemical processes? The full details of current work at California, when published, may bring the first view of a revolution in photochemistry as well as new knowledge about the mechanism of plant-growth.

Notes & Comments

Exhibition Catalogue

INTO this office a short time ago came a bulky, and quite a heavy, parcel; some 12 inches by 9 inches, it weighed about 5½ lb., and was found to contain a guide to an exhibition. It was, in fact, the Achema Jahrbuch 1953-55, nearly 900 pages long and written throughout in German, French and English—even, at two places, in Spanish. This mammoth volume, edited by Dr. H. Bretschneider, has been published by the Deutsche Gesellschaft für chemisches Apparatewesen for the guidance of visitors to the Achema XI Exhibition & Congress of Chemical Engineering, which will be held in Frankfurt from 14 to 22 May. 'However,' say the publishers, 'you do not have to take this heavy book with you to Frankfurt,' since registered participants in the Congress will also be provided with a free copy of the Congress Handbook. The feats of organisation whose outcome is these two volumes, and indeed the whole of the Dechema set-up, represent a peculiarly German genius. No other European nationality has ever proved capable of the relentless marshalling of facts, the religious attention to petty details, which characterise both German research and German documentation. We glanced through the contents: 19 forewords from representatives of the chemical engineering profession in Germany, France, Belgium, Holland, Austria, Switzerland, Yugoslavia, Spain, Britain, Finland and Luxembourg; details of facilities and research carried out at 26 European schools of chemical engineering; reports on recent developments in the plant, machinery and supplies industries, listed under manufacturers; and, with the title 'Who can supply? Who can furnish information?' some 6,000 references, in three languages, to manufacturers and suppliers of plant and laboratory apparatus.

Not in the Picture

BUT although this is to be a European convention, with the full support of the European Federation of Chemical Engineering, it soon becomes apparent that German companies enjoy major representation in this volume and at the exhibition. We turned back to the beginning of the book, and read again through the 19 forewords and 26 descriptions of chemical engineering schools. Although there are messages of greeting from all the major societies in Europe, there is no official foreword from any society in Great Britain, the only British contribution being by an independent—indeed, a very independent—representative, Dr. F. A. Freeth. Similarly, the Continental reader of this volume could be forgiven for believing that the only institution in Britain at which the science of chemical engineering is taught is Professor F. H. Garner's department in the University of Birmingham. This sort of thing does no good to Britain—either to her reputation or her trade. Why has there been this marked exclusion from the Achema yearbook? The answer is easily discovered. The exhibition and convention to which the book owes its existence are sponsored by the European Federation of Chemical Engineering—and Britain is not a member of the Federation. Twenty-three associations of chemical engineers are affiliated—since the publication of the yearbook the Swedish Ingeniors Vetenskaps Akademien has joined, and the Indian Institute of Chemical Engineers become a corresponding member—yet the only person representing British interests, Dr. Freeth, does so at his own expense, and with scarcely a suspicion of official support from either the Institution of Chemical Engineers or the Society of Chemical Industry.

Standing Aloof

THE 'official' reason, put forward by the Institution for their withdrawal from the embryonic federation in 1951 and their subsequent non-intervention, is that they are a professional and scientific body, and have no desire to become implicated with the commercial interests now involved in the European Federation. But chemical engineering is essentially a commercial

science: as its practitioners themselves continually point out, it consists in the design and erection of actual plant, on an actual site, for an actual process—and there is no doubt that these will be thoroughly commercial operations. Moreover, the business of chemical engineering is becoming increasingly an international one, and no British company can afford to lose any chance of representation anywhere in Europe. General opinion at the Institution is that the European Federation will eventually come round to the British idea—an oddly mid-Victorian, jingoistic attitude, in keeping with the usual atmosphere at 56 Victoria Street. But the Federation is two years old, has the support of nearly every important society of chemical industry on the continent, and is rapidly strengthening its position. Of course, mistakes are being made, but there is immense vitality and keenness in evidence. The situation certainly will not be eased by the conference in London next week on 'The Functions & Education of the Chemical Engineer in Europe', which the Institution is organising. It looks only too obvious that Britain is out to wipe the eye of the European Federation, and that is no way to win friends and influence people.

A *Part for Everyone*

THERE is a role for every nation to play in an international association: for the Germans, with their thoroughness and organising ability, their passion for documentation; for the French, with their amazing flair for getting results from completely out-of-date plant; for us, with our versatility, our intuitive approach to research and our flexible construction of plant—and there is a need for every nation to work amicably with every other nation in the study of a science whose very limitations have made it essentially an international one. Speaking at a Press conference last week, Mr. F. E. Warner, Joint Hon. Secretary of the Institution, said that the most important thing in chemical engineering was personal contact between its practitioners—surely no better argument could be found to support the entry of Britain into the European Federation?

Catalytic Oil Gas Plans

The South Eastern Gas Board are proposing to install and operate a SEGAS catalytic oil gas plant in conjunction with the British Petroleum Co.'s Kent oil refinery. It is expected that the initial installation will convert some 50,000 tons a year of petroleum products to gas, with a daily output of 15,000,000 cu. ft. Final plans would allow for production of 40,000,000 to 45,000,000 cu. ft. daily, equivalent to 150,000 tons of oil, and saving 700,000 tons of coal.

Lunch for Duke of Edinburgh

The Duke of Edinburgh will attend the annual luncheon of the British Plastics Federation at the Savoy Hotel on 26 April.

A party of 16 Chicago pharmacists visited Glaxo Laboratories Ltd., Greenford, recently. During their visit they saw preparation of various antibiotics and pharmaceutical products; they were particularly impressed with new British methods of filling streptomycin. Our picture shows some of the visitors in conversation with Dr. L. Parker, of the biochemistry unit

Contracts & The Chemist

by H. WARSON, B.Sc., F.R.I.C.
(Hon. Editor, 'The British Chemist')

THE case of Marchon Products *v.* Thornes, which was decided in the High Court a short while ago, has proved of very considerable interest to both chemists and employers. In this particular case the validity of a restraint clause was upheld, the relevant part stating that 'The Chemist shall not for a period of one year from the date of termination of his employment . . . engage on any works or processes . . . with which his work for the Employer has made him familiar. If consent (by the Employer) be withheld the Employer shall pay to the Chemist . . . one half of the annual salary. . . .'

Mr. Justice Danckwerts, in summing up, stated that there must be an element other than competition done to make such an agreement valid, and access to confidential information or secrets was such an element. In this particular case he ruled that the work of the defendant, who was in charge of an analytical section, came within the category of secret information.

Honouring Agreements

It has long been assumed that all agreements of this type cannot be enforced in a court of law, and this case clearly demonstrates the falseness of this outlook. In the current issue of *The British Chemist*, journal of the British Association of Chemists, Norman Sheldon, A.R.C.S., F.R.I.C., a former president of the BAC, deals generally with the question of the sanctity of agreements. He points out that a chemist, who is a respected member of an honourable profession, must be a person of the highest integrity, and if he signs an agreement, he must do so with the sincere intention of honouring its terms. On the other hand no firm of repute would object to a chemist taking the utmost care in considering a draft agreement.

While the Marchon Products *v.* Thornes case may focus attention on the important aspect of honouring agreements freely negotiated, yet nevertheless it does raise several serious problems for chemists, and also for organisations which guard their interests. (Incidentally the results of this case were considered at length in a recent issue of *The Royal Institute of Chemistry Journal*). While it is a common law obligation of an employee to preserve at all times the trade secrets of his employers and not to entice away the customers of any former employer, it is extremely difficult to draw even a shadowy boundary between a 'trade secret' and the general knowledge and experience gained in the course of a chemist following his profession.

Unhappy Precedent

Since however analytical work is normally regarded as the least secret of all work on which a chemist might be employed, it might seem that if Marchon Products *v.* Thornes is regarded as a precedent the net of secrecy could be drawn very wide indeed. It must be realised that it would be difficult for a chemist in any future case that might arise to obtain adequate expert witnesses to support his case, although it would be comparatively simple for the employers. An expert witness chosen by the chemist must of necessity be a 'neutral' witness, and it may well be difficult to produce such a witness who might easily, either directly or through his own employers, be in business contact with the firm endeavouring to enforce a restraint.

It must be admitted that it is very easy to impress a layman with the importance of a 'trade secret,' and one must include members of the legal profession in the category of layman. A formula or process which might appear obvious to anyone 'skilled in the art' to quote the standard patent jargon, might seem very hush-hush to the non-technical minded person, even to non-technical directors of an industrial concern. The whole of German industry was opened wide to the teams of allied investigators after the war, but seems to have come to no major harm.

Restrictive contracts are not the only professional difficulty with which chemists have to contend. It is widely believed that there are a number of 'gentleman's agreements' among a number of firms not to employ each other's staff, although concrete proof of the latter is naturally difficult to obtain.

Chemists as a whole do not indulge in any

restrictive practices. There is no category of work restricted to, say, an A.R.I.C., or a Ph.D. It would seem scarcely in the country's interest that the employment of chemists should be subject to unnecessary restrictions.

There may be some cases where a slight restriction would be desirable, as when a chemist had been engaged on a lengthy development process which had not yet reached the patent stage. Perhaps the maximum a restriction clause should contain would be a clause which would permit a restriction to be enforced where a chemist was engaged on new processes or products under development only; analytical work, process control, and general development work might be specifically excluded. In addition no contract should imply any restriction longer than one year, and in this event full salary up to £1,000 per annum should be paid during the restriction period and one half of the excess over £1,000 per annum.

A generally acceptable contract of service depends however on both the chemist and the potential employer, and in general relations have been very harmonious in the past. It would be a pity if this general relationship were interfered with by attempts to enforce oppressive contracts.

The British Association of Chemists will be very pleased to give advice to its members on the subject of contracts, this being one of the many services available. It is a matter of considerable importance.

More Pay for Teachers

THE Government is reviewing the whole question of scientists in the public service so as to ensure that the best use of them is made, Sir David Eccles, Minister of Education, said in reply to a question in the House of Commons recently. He had announced pay increases for teachers and pointed out that the greatest anxiety was in the fields of science and mathematics.

The Federation of British Industries, he added, was asking all its members not to raise salaries in competition with the Burnham proposals and to review the use they made of science graduates. The Federation was also bringing to the notice of its members the desirability of graduates in industry giving part-time service in the field of science education.

Solving a Problem

THE problem of 'stress-relieving' the reactor casing at Calder Hall atomic power station was tackled recently by Whessoe Ltd., of Darlington. The casing, a huge cylindrical vessel, was 40 ft. in diameter, 60 ft. high and weighed 400 tons. There was no gas heated furnace large enough to take it, so it was decided to heat it electrically.

A network of stainless steel tubing 2,000 ft. in length was installed inside the vessel. A heavy electric current was passed through this framework which was raised to red heat. The inside of the vessel thus became one enormous electric fire.

It took several days to raise the temperature of the steel walls of the vessel to the required temperature, at which the vessel was maintained for some hours to complete the stress relieving operation. Thereafter it was allowed to cool down very gradually to normal temperature.

In order to conserve heat and, even more important, to ensure that the thick steel shell reached a uniform temperature at all points, the whole of the outer surface of the vessel was covered with insulating material several inches thick.

New Industrial Fibre

BEFORE the end of 1955 Celanese Corporation of America will begin full-scale commercial production of X-36, a super-strong industrial fibre which has been under development and evaluation for the last four years. Equipment and machinery are now on order for the operation, which will be located at the Rome, Georgia, plant of the company.

Although a chemical brother to Fortisan, the regenerated cellulose yarn which Celanese launched in 1940, X-36 is made by an entirely new and different process developed specifically for the production of the heavy deniers required in industrial applications. The product will be marketed as Fortisan-36 in continuous filament form, and at the outset will be available in 800 denier continuous filament. Other sizes in the heavy denier ranges may be produced. Its strength, low elongation and dimensional stability make it of value in such fields as power transmission belting, high pressure hose, fire hose, conveyor belts, webbing, body armour and backing for heavy duty carpets.

Distribution Problems

Deciding Fair Shares of DSIR Funds & Staff

REPORT for the year 1953-54 of DSIR is mainly of interest for the Advisory Council's recommendations for using the increased resources made available to the Department under the Five Year Plan (THE CHEMICAL AGE, 1953, **69**, 1317; 1954, **70**, 719).

Indications are given of the way the Advisory Council is thinking on the distribution of the resources, but no hard and fast plan for the whole period is contemplated. A changing, not a static, situation is being dealt with and the Advisory Council is constantly reviewing the relative importance of work already in hand and new proposals. The Advisory Council has accepted the five year plan, 'not regarding it as an arbitrary dole of resources to be applied to the Department's work, but as an acceptable current assessment of the share of Government expenditure and of the country's scientific manpower to be devoted to this purpose.'

Most pressing was an interim decision on staff for the current year. An increase of about 150 non-industrial staff was authorised for 1953-54. The Advisory Council advised that rather more than two-thirds of the total should be distributed among five research laboratories most urgently in need: the Mechanical Engineering Research Laboratory, the Fuel Research Station, the Road Research Laboratory, the Water Pollution Research Laboratory and the Hydraulics Research Station.

The report also notes the increased provision in the Department's estimates for 1954-55 for grants to the industrial research associations and, in those of the Ministry of Works, for building services for the Department.

Industry Must Help

In 1952 the Building Research Station suffered economy cuts and the case for the allocation of further funds and staff to this station is particularly discussed. It is recommended that any further substantial increase in the resources for building research must be sought outside the Department. 'We have no doubt,' the Advisory Council state, 'that there is justification for extending research on building but . . . there must be a limit to the proportion of the resources available for the Department's establishments which can be devoted to this activity. We hope there will be some further expansion, but we do not expect that the staff can, or should, continue to increase, at Government expense, proportionately to the total increase in the Department as a whole. . . . We . . . suggest that any further substantial increase in the resources for building research, within the Department or elsewhere, must be sought outside the Department. . . . The building industry as a whole does not appear to make so large a contribution to research for its benefit as do most industries and as it might do.'

Unsatisfactory Premises

Of the Fuel Research Station, the Council says '. . . the present premises at Greenwich are old and unsatisfactory. . . . In spite of the establishment of new organisations, the demands on the Fuel Research Station are still heavy and difficult to meet satisfactorily.' The Fuel Research Board reported to the Council that it was acutely conscious of two major needs—more staff and the rapid provision of a new research station. 'We are therefore giving careful attention to the special problems of this station. . . . We have no doubts of the urgent need of a new station, but it must be planned on the basis of a clearly defined policy. In our view the presence of various research organisations in the fuel field in no way reduces the necessity for the station to maintain its position as a national centre for the study of fuel problems.' Increased staff has been allocated to the station to accelerate work on atmospheric pollution and domestic heating.

The terms of grant to research associations normally are reviewed every five years. During 1953-54 the Advisory Council recommended new terms of grant to 10 research associations. The overall effect was to increase slightly the maximum amount of Government support which they could receive but to require them to raise substantially more industrial income to qualify for it. In addition initial grants were recommended to two associations new to the Gov-

ernment scheme—the British Steel Castings Research Association and the Chalk, Lime & Allied Industries Research Association.

An innovation is reported in maintenance allowances to post-graduate students in engineering. Graduates in engineering, even if likely to embark on a career in research, should acquire practical experience in industry, but when they have acquired this they can earn considerably more than the maintenance allowances normally payable by the Department for training in research. To offset this deterrent, post-graduate students in engineering above a certain age may be awarded grants at higher rates.

Economic Limits Reached

OCCA Exhibition Packed Out

GIVING the address of welcome to approximately 300 members and their guests at the Exhibition Luncheon of the Oil and Colour Chemists' Association on 15 March, Mr. R. F. G. Holness, chairman of the London Section, said that he wondered whether the economic limit to the size of the exhibition had not been reached. When the Association's exhibition, the seventh to be held, was opened by Sir Wavell Wakefield an hour or so later, the Old Hall of the Royal Horticultural Society was uncomfortably full and many people expressed the opinion that in future years a larger hall would have to be employed.

The luncheon, which was held at a Piccadilly Circus restaurant, was presided over by Mr. Holness and the principal guest was Sir Wavell Wakefield, the immediate past chairman of the Parliamentary and Scientific Committee. The London Section of OCCA, which organised the exhibition, also entertained a number of national leaders of the paint, colour and printing ink industries.

This was the second year in which the OCCA Technical Exhibition had been held in the Old Hall, for until last year it was always held in the Borough Polytechnic. For the 1954 exhibition it was felt that more spacious premises were needed and, with an increase of 40 per cent in exhibitors at this year's exhibition over the total last year, it is not surprising that some people consider that next year the New Hall of the Royal Horticultural Society may be necessary. Although the exhibition lasted three days, the hall was frequently very crowded and at times it was difficult to get near certain stands.

The exhibition provided a focus for the technical display of advances in materials, equipment and technology by the suppliers to the industries covered by the Oil and Colour Chemists' Association, and the opportunity for their direct discussion between the technical men of suppliers and consumers. The exhibition is now firmly established as one of the most important events in these industries.

Building at St. Helens

A START is to be made this month on the construction of the first phase of the £750,000 technical college on a site nearly four acres in extent which surrounds Brook Street, St. Helens (Lancs). On an adjoining site work has already begun on another major building development, the construction of extensions to the premises of Beecham (Northern) Ltd. The first phase of the technical college, costing £145,000, will ultimately form the rear portion of the completed college. Beechams are linking up previous extensions of 1935 and 1948 with a four-storey factory construction.

First phase of the technical college, due for completion in March, 1957, will provide classroom accommodation, drawing offices, engineering laboratories, electrical workshop and a foundry. Alderman J. Hughes, chairman of the Technical College Sub-Committee, said: 'The college will be an educational showpiece for St. Helens and a great asset to the cause of technical education.' Existing headquarters of technical education are at the Gamble Institute which was handed over to the town by a leader of the chemical industry in 1896.

Pure Alkaline Earth Compounds

John & E. Sturge Ltd. announce that they are now manufacturing a range of pure alkaline earth compounds, including calcium and barium carbonates and monohydrogen orthophosphates (anhydrous). These compounds, which are manufactured in bulk to a rigid specification, are primarily designed for the manufacture of phosphors for fluorescent lamp and cathode-ray tubes, but also find other industrial applications.

THE MIDLANDS SOCIETY FOR ANALYTICAL CHEMISTRY

Analysis of Titaniferous Materials

AT a meeting of the Midlands Society for Analytical Chemistry held on 11 January in Birmingham, Dr. F. R. Williams, chief analyst to the British Titan Products Co. Ltd., delivered a paper entitled 'Some Aspects of the Analytical Chemistry of Titaniferous Materials.'

Dr. Williams opened his lecture by saying that the analyses most commonly carried out in titanium technology are those of the ores ilmenite and rutile or of titanium dioxide pigments. Owing to the refractory nature of these materials, and the consequent difficulty of bringing them into solution, most of the associated elements are determined by physico-chemical methods. A further source of trouble to the analyst arises from the similarity between the properties of some of these elements and those of titanium itself.

Solution of Sample

The difficult problem of dissolving the sample was solved in the case of the pigment by the use of concentrated sulphuric acid and ammonium sulphate. For this purpose 0.2 g. of the titanium dioxide is placed in a 500 ml. Pyrex beaker, and treated with 25 ml. of concentrated sulphuric acid and 20 g. of ammonium sulphate. When heated strongly for 20-30 min., this mixture yields a clear yellow solution, which becomes colourless on cooling. The cold solution is then cautiously diluted with 300 ml. of distilled water.

Titanium dioxide pigments are frequently extended with blanc fixe, or barium sulphate. If such a pigment is to be analysed, then the same procedure is applicable, though it is advisable to use a slightly greater quantity of the sample; 0.5 g. constitutes a suitable amount. The barium sulphate dissolves in the mixture of sulphuric acid and ammonium sulphate, but precipitates out during the dilution.

This method is particularly valuable since it permits of the easy determination of barium sulphate in the extended titanium dioxide pigment, a factor of no little importance in adjudicating the applicability of such a preparation. To this end the solution is allowed to boil for a few minutes and then kept hot for four hours, after which the precipitate is filtered off, washed first with dilute sulphuric acid (1 : 10) then with hot water, and eventually ignited. The filtrate and washings are combined, and serve for the determination of titanium.

Titanium ores are resistant to the reagents mentioned above, and are, therefore, much more difficult to dissolve. In general, it is necessary to fuse the ore with potassium pyrosulphate before solution can be effected.

The determination of titanium may be accomplished in a number of ways. Both gravimetric and titrimetric procedures are available. Of these, the latter are usually preferred owing to their greater rapidity. The former, however, are more suitable for laboratories where titanium analyses are carried out only occasionally, since they require no special apparatus and offer less difficulty to the inexperienced operator.

The most common gravimetric methods depend upon the precipitation of the hydrated dioxide, phosphate, cupferronate or the titanium salt of *p*-hydroxyphenylarsonic acid or some closely related compound.

Pigments & Ores

In the analysis of titanium dioxide pigments, it is most usual to precipitate the titanium in the form of its hydrated dioxide, which is then redissolved. The final precipitation is effected by means of cupferron, the precipitate being ignited to the oxide.

The titanium solution, containing a few drops of methyl orange, is treated with ammonium hydroxide (1 : 1) until its colour turns to a distinct yellow. The mixture is then brought to the boil and filtered. The precipitate, after being washed with warm 1 per cent ammonium hydroxide solution, is transferred back to the original beaker, where it is dissolved in 100 ml. of hot hydrochloric acid (1 : 1). The acid solution is diluted to 400 ml., filtered and cooled below 15° C. Then 50 ml. of a 3 per cent cupferron solution are added, and the resulting yellow flocculent precipitate is filtered off, and washed with a 2 per cent solution of ammonium chloride containing a little hydrochloric acid. When the filter paper has been carefully burned off, the precipi-

tate is strongly ignited, and then weighed as titanium dioxide.

The analysis of ores presents greater difficulties owing to the presence of other elements. The cupferron procedure provides a separation from numerous elements, including chromium and aluminium. Ilmenite, however, contains large quantities of iron, and this element must first be reduced to the ferrous state. Similarly, before the precipitation of titanium phosphate, all the iron must be reduced. The various reagents containing the arsonic acid grouping serve to separate titanium from iron and many other elements, but are subject to interference from quadrivalent metals such as zirconium, ceric cerium and tin.

Owing to the ready hydrolysis of titanium salts, it is possible to precipitate hydrated titanium dioxide without risk of contamination by various of the associated elements. One method which has found a good deal of favour consists of adjusting the solution to *p*H 2 after preliminary reduction of the iron, and then saturating it with sulphur dioxide. The resultant mixture is sufficiently acid to keep the titanium in solution, but on boiling the sulphur dioxide is expelled, with consequent increase in the *p*H value of the solution and precipitation of hydrated titanium dioxide.

This procedure is an example of precipitation from homogeneous solution, and therefore yields a precipitate of great purity. Furthermore, it has the advantage of being a precipitation in a reducing medium which ensures the complete absence of ferric iron and so precludes the precipitation of ferric hydroxide. Before this elegant method can be adopted, the titanium must be converted into its chloride.

Titrimetric Methods

As has already been stated, titrimetric methods are in general more satisfactory than gravimetric ones for the determination of titanium. They comprise for the greater part the reduction of the titanium to the titanous condition with subsequent titration by means of a suitable oxidising agent.

The reduction is usually achieved by means of a metal or metal amalgam, the most commonly used of these being zinc amalgam. A suitable reducing agent is prepared by adding small pieces of zinc to mercury kept under 2 per cent sulphuric acid, the whole being heated on the steam bath. When a sufficient quantity of zinc has dissolved to form a 3 per cent amalgam, the mixture is cooled, left to stand for a few hours, and then filtered. It is stored under 2 per cent sulphuric acid.

The oxidising agent used for the titration is usually ferric alum. Although iron will be reduced by the amalgam, it will clearly not be reoxidised by ferric alum and therefore does not interfere. Potassium thiocyanate is a convenient indicator.

Another titrant which has been used is methylene blue, which is reduced by titanous salts to its colourless leuco-base. The reagent therefore acts as its own indicator and, like ferric alum, is not subject to interference from iron. It has, however, the disadvantage that the titanous solution must be hot, so that it is not suitable for use with some of the equipment described below.

Recommended Apparatus

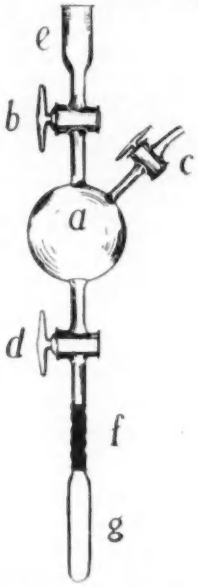
Various types of apparatus have been recommended for the titrimetric determination of titanium. That of Knecht and Hibbert consists of a conical flask closed by a rubber bung with three holes. During the reduction, two of the holes are closed, and the third is fitted with a bunsen valve through which passes a platinum wire holding a piece of zinc. The latter is allowed to dip into the solution and so to bring about the reduction of the titanium. When this is complete, the zinc is withdrawn, and the titrant introduced through the second hole while carbon dioxide is being passed in through the third.

Another type of apparatus for this purpose is the Jones reductor which consists of a long tube packed with pieces of zinc previously activated by treatment with mercuric chloride. The reductor is fitted with a tap and an extension tube, the latter being connected through a bung to a Buchner flask. Suction is applied by means of a pump, and the titanium solution is poured down the reductor into an excess of ferric alum contained in the Buchner flask. The ferrous iron so produced is then titrated with potassium permanganate.

The most convenient reductor, however, is that due to Nakazomow and is shown in the diagram. The bulb *a* is of 350 ml. capacity, and the flask *g* holds 50 ml. Its mode of use is as follows:

The flask *g* is attached by means of thick rubber tubing *f*. The taps *b* and *d* are opened, and 4 per cent sulphuric acid is

poured into the apparatus until it reaches the level of the tap *d*. This is now closed, and 20 ml. of zinc amalgam are poured into



the flask, followed by 300 ml. of the titanium solution, which has been heated to a temperature of 60° C. The air is then swept out of the apparatus by means of nitrogen or carbon dioxide introduced through *c*, after which the taps *b* and *c* are closed, and the whole apparatus is vigorously shaken for five minutes. The mercury amalgam is then run into the flask *g*, care being taken to avoid loss of titanium during this operation.

The gas supply is reconnected, both *c* and *b* being again opened. After the addition of 10 ml. of 10 per cent potassium thiocyanate, the contents of the flask are titrated with N/16 ferric alum solution until a faint pink colour persists for one minute. For this purpose, a piece of very narrow glass tubing is attached to the burette, and is allowed to pass into the bulb *a*.

Titanium can be determined colorimetrically by means of hydrogen peroxide which converts it into the intensely yellow pertitanic acid. This method, however, is principally of use for the analysis of materials of low titanium content rather than for that of titanium ores and pigments.

At the end of his lecture, Dr. Williams referred to the results of some of the analyses of titanium ores, and suggested an interesting geological connection between ilmenite and rutile.

Iron in Ores & Slags

BRITISH Standards Institution has recently published Part 33 of BS. 1121, 'Method for the determination of iron in ores, slags and refractories.' It is in two parts, the first being a volumetric method with a range of 0.05 to 100 per cent iron. In this method the solution of the sample in sulphuric or perchloric acid is reduced by hydrogen sulphide, and any precipitated sulphides are filtered off. Excess hydrogen sulphide is eliminated by boiling, and the ferrous iron is titrated with a standard potassium dichromate solution using barium or sodium diphenylamine sulphonate as an internal indicator. The second part deals with an absorptimetric method which has a range of 0.01 to 1.0 per cent iron. A sulphuric acid solution of the sample is prepared and the iron converted to a coloured complex with thioglycollic acid.

Copies of this standard can be obtained from the British Standards Institution, 2 Park Street, London W.1, price 2s. 6d. each.

Aluminium Analysis

THE British Standards Institution has announced the publication of Parts 6 and 7 of BS. 1728:1955, 'Methods for the analysis of aluminium and aluminium alloys.'

Part 6 relates to the volumetric determination of iron with titanous chloride for use with alloys containing between 0.1 and 5.0 per cent. Part 7 relates to the determination of zinc by the zinc oxide method, and is an additional method to those specified in Parts 3 and 4 (already issued). The method is for use with alloys having a zinc content of 2-15 per cent.

The methods specify the reagents to be used, recommended methods of sampling and test procedure. An indication of the reproducibility expected is given, and is derived from experiments carried out by a number of independent analysts. Copies of this standard may be obtained from the British Standards Institution Sales Branch, 2 Park Street, London W.1, price 2s. each part.

Fumigation

Pesticides Group Discuss Methods

VACUUM fumigation was the subject of the meeting of the Pesticides Group of the Society of Chemical Industry, held in the rooms of the Chemical Society on 21 February.

Describing the 'Physico-chemical Effects,' Mr. W. Burns Brown referred to results obtained at the Pest Infestation Laboratory by measuring concentrations inside commodities fumigated with given gases. The initial objects had been to compare different techniques of using vacuum fumigation and to assess any advantages over treatment at atmospheric pressure. Changes in concentration at different positions were illustrated graphically for HCN and MeBr, these two gases respectively being highly and almost not absorbed.

Of the vacuum techniques at present used, Mr. Burns Brown concluded that the sustained vacuum method is the best for achieving a good penetration. He pointed out that his results did not support certain previously made statements that sorption of fumigant is less at low pressures, or that letting in air and evacuating at the end of the exposure—'air washing'—is an efficient way of removing fumigant at the end of a treatment.

Dr. A. B. P. Page, in a paper on 'Biological Aspects,' referred to work on the effects of certain insects of low pressures alone and without using a fumigant. He pointed out that, above 2 cm. Hg, low pressures of themselves appear to have no effect. He considered the sorption of fumigants by insects and pointed out that none of the results available on the toxicity of fumigants at different atmospheric pressures suggested that any smaller dose can be employed if a vacuum technique is used. In conclusion he stated that for most practical commercial purposes he thought that vacuum techniques could be put aside in favour of chambers with rapid stirring employing methyl bromide.

In answer to a question from Mr. N. K. Smith, Mr. Burns Brown pointed out that although vacuum fumigation is employed widely in France, Canada, USA, and elsewhere, very few plants are used in the UK. Dr. Turtle amplified this answer by stating that the work described in the two papers had for the first time provided a sound basis for advising intending users whether to employ vacuum or atmospheric techniques. Dr. Page explained the technique of taking samples from a chamber containing fumigant at a low pressure.

Aluminium Skyscrapers

COLOURED aluminium clad skyscrapers are in prospect for America. The Aluminium Company of America is going to cover Pittsburgh's newest skyscraper in blue aluminium. Last year the company used coloured aluminium sheets for the first time on its own office building in Cincinnati, a combination of blue and gold. ALCOA hopes that the new Pittsburgh skyscraper, the 16-storey Pennsylvania State Office Building, will set a vogue. The rainbow-hued metal is suitable for churches, schools and even homes, the company says.

Ordinary silver-coloured structural aluminium is in wide use. Last year, in a demonstration of the economy in labour costs which structural aluminium offers, the bare beams of an entire New York skyscraper were covered with exterior aluminium walls in nine and a half hours. The coloured aluminium sheets are rather more expensive than silver ones, but ALCOA believes the added beauty offsets any difference in price.

Tall Oil Progress

MEMBERS of the Tall Oil Association were reassured by their president, Albert Scharwachter of Arizona Chemical Company, at their early spring meeting in Key Largo, Florida, last week, that by 1960 tall oil production would reach an annual rate of 300,000 tons. Production in 1954 had approximated 180,000 tons, second only to 1951, with output in the final months of the year running at an annual rate well above previous records. During the past ten years when production of oleic acid, raw linseed oil and peanut oil had stood still or declined, tall oil had enjoyed a 250 per cent increase in production.

Later at the meeting the formation of a new Pulp Chemicals Association was considered which association, if organised, would have a Tall Oil Division, a Sulphate Turpentine Division, a Tall Oil Fatty Acids Division, and later possibly a Tall Oil Rosin Division.

Vigorous Infant or Lively Veteran?

AGM of Society for Analytical Chemistry

EIGHTY-FIRST annual general meeting of the Society for Analytical Chemistry was held on Friday, 4 March, in the meeting room of the Royal Society, Burlington House, with the president, Dr. D. W. Kent-Jones, in the chair. The financial statement and the report of the Council for the past year were submitted and approved. The membership of the Society at the date of the meeting was 1,799, an increase of 153 compared with the corresponding figure last year. During the year the Society held five ordinary meetings in London (two of which were organised by the Biological Methods Group and one by the Microchemistry Group) and a joint meeting with the Oils and Fats Group of the Society of Chemical Industry. In addition, the Society's sections and groups held 21 meetings.

Two special meetings were held during the year in the lecture theatre of the Royal Institution in London. The first, on 'The Use of Perchloric Acid in Analytical Chemistry' was devoted to a paper by Professor Harold Burton and Dr. P. F. G. Praill and a paper accompanied by numerous demonstrations by Professor G. Frederick Smith, who came specially from the University of Illinois to speak to the Society; the audience was over 500. At the second, Professor G. Schwarzenbach, of Zurich University, spoke on 'The Complexones and their Analytical Applications,' this lecture being illustrated with demonstrations by Dr. H. M. N. H. Irving. An audience of 579 filled the lecture theatre.

Officers & Members of Council

The following officers and members of Council were elected for the forthcoming year—*president*: K. A. Williams; *past-presidents serving on the Council*: Lewis Eynon, D. W. Kent-Jones, J. R. Nicholls and George Taylor; *vice-presidents*: C. A. Adams, D. C. Garratt and H. M. N. H. Irving; *honorary treasurer*, J. H. Hamence; *honorary secretary*, N. L. Allport; *other members of Council*: D. C. M. Adamson, C. H. R. Gentry, J. Haslam, C. L. Hinton, W. C. Johnson, A. G. J. Lipscomb, T. McLachlan, R. F. Milton, Miss Mamie Olliver, S. A. Price, R. E. Stuckey and C. Whalley; *ex-officio members*: J. R. Walmsley (chairman of the North of England Section), F. J. Elliott (chairman of the Scottish Section), H. J. Evans (chairman of the Western Section), J. R. Leech (chairman of the Midlands Section), G. F. Hodsman (chairman of the Microchemistry Group), A. A. Smales (chairman of the Physical Methods Group), and L. J. Harris (chairman of the Biological Methods Group).

The Council appointed Dr. R. E. Stuckey to be honorary assistant secretary of the Society.

President-Elect Installed

In installing the president-elect in the chair, Dr. Kent-Jones congratulated the members on their choice of one who had served the Society so well as its honorary secretary and in many other ways. The new president, Dr. K. A. Williams, thanked Dr. Kent-Jones and recalled how he had first found himself concerned in the affairs of the Society some 30 years ago. He then called on the retiring president to deliver his presidential address.

Dr. Kent-Jones spoke on analytical chemistry generally, with special reference to the past and possible future of the Society. He recalled that in 1928 the late E. R. Bolton, in his presidential address, had said that the Society was no longer small, as it them numbered 580. While this was large compared with its size in 1909, when the membership was 350, and 1919, when it was 450, it was only a third of what it now was. This growth took place during and after the last war. The introduction of the three groups dealing with methods of analysis had widened the interests of the Society by including microchemical, physical and biological approaches to the problems of analysis.

The growth of interest in the Society had been accompanied by expansion in the office; ten years ago, the Society was run almost entirely by honorary officers and voluntary workers, with only an editor and part-time clerical assistance; indeed the Society took an office—one room—in Idol Lane as late as 1946. This year would see the Society in reasonably spacious offices on the top floor of the new building acquired by the Society

of Chemical Industry, to whom he expressed the thanks of the Society for co-operation and generosity. The staff now numbered 12. Since 1948, the Society's expenditure had trebled, although the subscription had only doubled. There were now some 3,000 subscribers to the Society's publications who were not members of the Society, treble the pre-war number.

The Analytical Methods Committee had been reconstructed, with new duties and a paid secretariat. The response to the appeal to industry for funds on behalf of the committee had been magnificent, and he found it difficult adequately to express his thanks to all the subscribers who had made it possible to put one of the principal duties of the Society on a sound financial footing.

Dr. Kent-Jones ended by expressing his thanks for the loyal and unstinting help given by the honorary treasurer, Dr. Hamence, and the honorary secretary, Dr. Williams, now to be president.

Anniversary Dinner

In the evening following the annual general meeting, a dinner to celebrate the eighty-first anniversary of the Society was held, by kind permission of the Prime Warden, Wardens and the Court of Assistants of the Fishmongers' Company, at Fishmongers' Hall, London Bridge. The members and guests, numbering 182, were received by Dr. D. W. Kent-Jones and Mrs. Kent-Jones.

The guests of the Society and of the president included Lord Adrian of Cambridge, O.M., P.R.S., Master of Trinity College, Cambridge; J. Arthur Rank, J.P., D.L., and the Hon. Mrs. J. Arthur Rank; Professor William Wardlaw, C.B.E., and Mrs. Wardlaw; Professor Harold Burton and Mrs. Burton; Sir William Ogg and Lady Ogg; Professor Sir Charles Dodds, M.V.O., and Lady Dodds; George Taylor, O.B.E., and Mrs. Taylor; Dr. N. C. Wright and Mrs. Wright; and Alan Baker and Mrs. Baker.

Proposing the toast of the Society, Lord Adrian said that he was uncertain whether he was proposing a toast to an infant society, one year old, or a venerable body 81 years old. If it was an infant it had remarkable vigour; if a veteran, it was remarkably well preserved. He commented on the early work of the Society, saying that when founded in 1874 it was concerned with preventing additions to food, such as alum to bread, copper sulphate to beer and red lead as colour to cheese.

Now the Society was concerned with dietary necessities, and the public was all vitamin-conscious. He recalled that 40 years ago he had worked in Cambridge in a cellar adjoining that in which Gowland Hopkins had performed his famous investigation into the dietary needs of rats.

Food was now only one of the many interests of the Society. Analysts worked out new methods for complicated compounds, and the Society kept in touch with the march of progress in the introduction of chromatography, polarography, electrometry and rheology. When the Society of Public Analysts became the Society for Analytical Chemistry in 1953, and a separate body was founded to take over the professional interests of Public Analysts, it became a learned society in the full technical sense, and was concerned with the whole field of analytical chemistry.

In his opinion analytical chemistry was one of the finest exercises in practical and academic scientific method. In coupling his toast with the name of the president, he said that he would not praise analytical chemistry too highly, as the president might very soon have other branches of chemistry to look after.

Retiring President Replies

Dr. Kent-Jones, in reply, thanked Lord Adrian for the able speech in which he had proposed the toast. The Society was vigorous and expanding, and was proud of the work it did for industry and the nation. It was a little venturesome. It was not so young as was suggested by its change of name, but there was no change of heart. He surrendered his office as president completely confident in the future success of the Society.

Dr. H. M. N. H. Irving, proposing the toasts of the guests, repeated the saying that the quality of a person was known by the company he kept. This might or might not be so, but it was true that the character of the Society could be told by the company of sister societies that it kept. He greeted Lord Adrian, always a peer among scientists, now a scientist among Peers, President of the Royal Society; Professor Wardlaw, president of the Chemical Society; Professor Burton, honorary treasurer of the Royal Institute of Chemistry (deputising for the president); and Sir

William Ogg, president of the Society of Chemical Industry. Also in the company he welcomed J. Arthur Rank, representing the milling industry, Alan Baker, president of the National Society of British & Irish Millers, and Norman Wright, Scientific Adviser to the Ministry of Food.

Mr. Rank said that it was a pleasure and a privilege to reply on behalf of his fellow guests. He was aware of the great importance of chemical analysis to industrial life; it was vital to films, flour and agriculture. He thanked the Society for its hospitality and wished it success in the years to come.

Dr. Kent-Jones then invested Dr. K. A. Williams with the presidential badge and wished him success during his tenure of the office. Dr. Williams replied, thanking Dr. Kent-Jones for all he had done for the Society in the last two years, and presented him with a replica of the Society's badge to wear as past-president.

Laminated Sheet Standard

NEW British Standard 2572 specifies requirements for a number of types of phenolic laminated sheet which, in general, have good mechanical qualities, electrical insulating properties and resistance to corrosive influences. The tests specified are designed to assess and differentiate between the types; they have not been selected in consideration of any particular use to which the material may be put.

The material is first divided into two groups: (a) where the mechanical properties in both directions are of the same order, and (b) where they are markedly different. The first group is then sub-divided into four classes, according to whether the sheet is manufactured with an asbestos, cotton fabric, cellulose paper or wood veneer filler. Altogether 14 different types of material are covered.

The standard specifies requirements for appearance, flatness, tolerance on thickness and marking of the material. Additionally, limits are laid down for the following physical properties: cross breaking strength, impact strength, water absorption, electric strength (both flatwise and edgewise), insulation resistance after immersion in water, and crushing strength after heating. Methods of test are specied in the appendices.

Copies are available from the British Standards Institution Sales Branch, price 4s.

New Research Association

THE first general meeting of the Chalk Lime and Allied Industries' Research Associaton was held on 9 March at the association offices at Hanover House, 73/78 High Holborn, London. This new research association, which is the latest addition to those working under the aegis of the Department of Scientific and Industrial Research, has been formed to conduct co-operative research for the industries indicated by its title. The preliminary work leading to the formation was done by the members of the Southern Lime Association of the same address.

At the meeting Mr. W. L. Clarke was elected chairman of the association and Mr. M. W. Hall vice-chairman. Mr. G. E. Bessey has been appointed director of research and has already taken up his appointment. Mr. Bessey was previously director of research of the research council of the British Whiting Federation and before 1949 was on the staff of the Building Research Station, Department of Scientific and Industrial Research.

Negotiations are at present in progress for a site for laboratories and for temporary accommodation until new laboratories can be built.

New Antibiotic Plant

A £2,500,000 fermentation plant built by Pfizer Ltd. at Sandwich, Kent, to manufacture terramycin and other antibiotic drugs, has now begun production.

Terramycin has been available on prescription since last November, and has been in use in certain hospitals for two years before that, but this is the first time its basic manufacture has been undertaken in this country, it is claimed.

The new plant's operation has had an immediate effect on terramycin prices, many of which have been substantially reduced. These reductions in its different forms—ointments, tablets, solutions—range generally from five to eight per cent, and became effective on Monday, 14 March.

Magnesium Elektron Ltd. Change

The British Aluminium Co. Ltd. has acquired a majority interest in Magnesium Elektron Ltd., previously a wholly-owned subsidiary of The Distillers' Co. Ltd.

Molecular Sieves

Synthetic Zeolites Have Many Uses

RECENTLY announced by Linde Air Products Co., a division of Union Carbide & Carbon Corporation, are two selective adsorbents prepared from man-made crystalline zeolites. These differ from naturally-occurring zeolites in that heating them to drive out adsorbed water does not result in collapse of the crystal structure. Instead there remains a porous crystal structure containing millions of cavities interconnected by a series of pores of uniform size, and only those molecules small enough to pass through these pores can be adsorbed. The zeolites are in fact 'molecular sieves.'

Linde synthetic zeolites are expected to find widespread use in all branches of industry. For example, in the drying of gases the efficiency of the operation is improved by their affinity for water vapour, their high capacity and their rapid rate of adsorption. In the separation of liquids, as long as one of the components has a molecular size sufficiently different from the other, and dimensions less than those of the pores, it is possible to obtain a better and more efficient separation than can sometimes be obtained by fractional distillation.

Marked Selectivity

In addition to their selectivity based on size, these molecular sieves show a marked affinity for both polar and unsaturated molecules, so that they will adsorb such molecules in preference to saturated or non-polar molecules of the same size. Other useful features are their high adsorptive capacity at elevated temperatures and their high capacity even when the component to be adsorbed is present only at extremely low concentrations. The new adsorbents will, for instance, adsorb water at temperatures as high as 100° C. Two other fields of application now undergoing investigation are catalysis and ion exchange; tests indicate that ion exchange capacity is higher than for many of the natural zeolites at present in use.

The molecular sieves are readily regenerated by heating and purging, and can be used over and over again, a point of considerable importance in cyclic processes. They are at present manufactured in two pore sizes. 4 Å and 5 Å diameter respectively—and are available in powder form or as $\frac{1}{8}$ and 1/16 in. pellets.

Royal Society Lectures

THE following arrangements for Royal Society Lectures during 1955 have been made by the Council of the Royal Society: The Croonian Lecture, founded in 1738, will be delivered on 16 June by Professor C. H. Best, C.B.E., F.R.S., University of Toronto, and will be entitled 'Dietary Factors in the Protection of the Liver, Kidneys, Heart and other Organs in Experimental Animals—the Lipotropic Agents.'

The Bakerian Lecture, founded in 1775, will be delivered on 28 April by Professor M. L. E. Oliphant, F.R.S., Australian National University, and will be entitled 'The Acceleration of Charged Particles to Very High Energies.'

Dunlop Special Products Move

The headquarters of Dunlop Special Products Ltd. have been transferred from 19-20 New Bond Street to Allington House, 136-142 Victoria Street, S.W.1, where Mr. Frank Smith, director and general sales manager, and his staff are now installed, as are Mr. Sam Perry, sales manager of the company's flexible plastics division, and his immediate London staff. The telephone number is VICtoria 6868, and the telegraphic address Dunsport, Wesphone, London.

New Northern Office for Aero Research

Aero Research Ltd. northern area office has now moved to larger premises at 409 Royal Exchange, Manchester 2. (Tel.: Blackfriars 9445-6). Technical service and sales of Aerolite, Araldite, Resolite and other of the company's synthetic resin products continue to be under the management of Mr. S. Hopwood, M.B.E., in the northern area.

Kwinana Platformer Starts

The platforming unit at the Kwinana Refinery, Western Australia, has been brought into commission. It is the second unit to begin operating since the first of the two distillation units was started up on 1 February. The remaining units are all expected to be in operation by the end of April.

New Steel Output Record

UK steel production during February amounted to a weekly average of 394,200 tons, exceeding the previous highest figure (in January) of 380,600 tons. Pig iron production also reached its highest figure, at 241,700 tons a week.

ORGANIC SYNTHESES. Vol. 34. By W. S. Johnson. John Wiley & Sons Inc., New York; Chapman & Hall Ltd., London. 1954. Pp. 121. 28s.

The service now provided by this annual publication is an excellent one. It gives accurate, independently checked accounts of the preparation of a range of organic compounds, the sources and grades of intermediates and solvents being specified and unfamiliar apparatus illustrated diagrammatically. Alternative methods of preparation are mentioned and a useful list of references is supplied. Nevertheless; there is further background information which could be supplied, and it is time that the editorial board considered its inclusion.

At present no clear indication is given as to why the preparations selected are considered suitable for publication. The early volumes of the series were concerned with the preparations of comparatively simple substances with obvious uses and little need of justification. The compounds which are dealt with in the later volumes may be unfamiliar to many, are in in many cases complex and their value obscure. While it is impossible to predict the trends of future research which may bestow significance upon the most unlikely compounds, many are because of their nature without promise of general currency.

For these reasons it would be valuable to the potential reader of 'Organic Syntheses' to know whether a compound had been chosen because its preparation illustrated a general method, because the product had value as an intermediate, or because it had some commercial significance. At present justification is left to the original contributor and a brief explanatory note sometimes appears in the text. It would be preferable to publish a short preface with the necessary editorial comments to provide a background to the following descriptive material. To exemplify this from the present text; the account of the preparation of ethoxyacetylene contains a note mentioning several synthetic routes in which it may be employed, while the preparation of azelanitrile and cetyl malonic ester are described as examples of general reactions. Other accounts are without any explanatory notes of this type.

There are 34 separate accounts of preparations, among the more unusual being the synthesis of diphenyl acetylene by the action of mercuric oxide upon the hydrazone of benzil, and the synthesis of *p*-tosyl-methylnitrosoamide, a safe substitute for diazomethane. A further preparation describes its use for the ring enlargement of cyclohexanone.—J. R. MAJER.

MODERN ASPECTS OF ELECTROCHEMISTRY. Edited by J. O'M. Bockris and B. E. Conway. Butterworths Scientific Publications, London; Academic Press Inc., New York. 1954. Pp. 344. 40s.

Just as there may be a long interval between the birth of an idea and its application in industry, so there is often a lengthy time lag between the development of new theoretical concepts in the original literature and their appearance in textbooks of science. 'Electrochemistry' is the first of a new series of volumes designed to bridge this widening gap.

While not written solely for the specialist it is assumed that the reader is at least familiar with the fundamental background of electrochemistry to degree standard as presented in current textbooks. Proceeding from this basis, the book provides what is essentially a group of review articles on aspects of electrochemistry in which either rapid development has taken place recently or is considered by the authors to be urgently necessary.

Each chapter is written by an active research worker in the field reviewed so that an authoritative and up-to-date account is guaranteed. Among the subjects dealt with are the physical chemistry of synthetic polyelectrolytes, electrode kinetics and the electrochemical properties of nerve and muscle.

The Chemist's Bookshelf

In all these fields there has recently been vigorous and exciting progress. The remaining topics, ionic solvation and the electrochemistry of interphases, fall in a different class. In these chapters the editors of the volume aim not so much at reviewing recent progress but rather at outlining sharply the difficulties which have hitherto prevented progress in these fields.

Nerve and muscle cells possess the property of undergoing transient changes of state which are propagated over the surface of the cell, as a wave of activity, electrochemical in nature, which is termed the 'action potential.' The section on the electrochemical properties of nerve and muscle outlines the difficulties which work in this important field has met with in the past and goes on to describe some fascinating experiments which have thrown much light on the origin and nature of this phenomenon. This chapter alone will for many readers make the book worth while. The article on electrode kinetics is particularly valuable for this is probably the field in which the most important theoretical advances have been made. No research worker in electrochemistry and certainly no teacher of physical chemistry should fail to read this article.

The publishers are to be congratulated upon undertaking this series of volumes and further issues will be awaited with interest. What a pity it is, though, that the price has to be so high.—R. C. PINK.

QUALITATIVE ANALYSIS USING SEMIMICRO METHODS. By E. S. Gilreath. McGraw-Hill Book Co. Inc., New York, Toronto & London. 1954. Pp. viii + 287. 35s.

This is a curious example of two excellent but almost completely independent books under a single cover. It is the result of carrying to extremes the view current in certain circles in the United States of America that the excuse for teaching qualitative analysis is that it provides a practical opportunity to pick up a lot of information about inorganic chemistry.

Up to page 175 the book presents an admirable introduction to such topics as atomic and molecular structure, solution chemistry and the like—the topics, in fact, that by long usage have somehow become indissolubly wedded to qualitative analysis. The second half gives an excellently set out programme of orthodox qualitative analysis. But nowhere is there any suggestion that the two should or could be married. The assignment schedule at the end of the book, showing concurrent class and laboratory work, only serves to stress this complete segregation of the two sections.

The more one meets books which tend in this direction (which is frequently) the more one is impressed by the need for chemical maturity in a student before he proceeds to qualitative analysis. In other words, if the first half of the present book were included in a general course of chemistry at an early stage in a student's training—right at the beginning, in fact—the second part would provide a good basis, a year or so later, for an analytical course. But the student who is expected to run the two concurrently is either a genius or must be spoon-fed to the point where he will actually be prevented from thinking for himself.

Having got rid of this general criticism, which is one of a class rather than of a particular instance, it should be stressed that each half of this book, apart from some few small matters, makes a favourable impression. On the whole the theoretical approach is modern, refreshing, and in some cases sufficiently novel to be striking. Indeed, it is just because of this that it is a bit startling to find the author lapsing into outmoded conventions here and there. On page 11, for example, he gives a description of circular and elliptical orbits almost in the same breath as he quotes Pauli's exclusion principle.

As minor points one might instance the fact that *gfw* and *m* are suddenly thrown in as abbreviations for 'gram formula weight' and 'molal' without any explanation of these terms, and that 'ammonia water' could well be replaced by 'aqueous ammonia.' It should be pointed out, too, that a normal solution (p. 29) does not furnish 1 g. of *hydronium* ions but 1 g. of hydrogen ions or 1 *gfw* of hydronium ions.

The text accompanying the tables for qualitative analysis is clear and interesting, and contains all the inorganic chemistry necessary for a full understanding of the analytical processes. There is little description of techniques, and it is presumed that the author expects information on this to be supplied by the class instructor.

This book will be extremely stimulating to teachers of chemistry, and few will read it without finding some new points of view. It will be clear from what has been said that it is not, in the reviewer's opinion, a suitable class text for elementary students. More advanced students could, however, use it as first-class revision reading.—CECIL L. WILSON.

FLUID HANDLING. General Editor, E. Molloy. George Newnes Ltd., London. 1955. Pp. viii + 207. 21s.

This book is a collective contribution by a number of authors all engaged in industry. There are 13 sections dealing with industrial water treatment, metering of fluids, drying of gases, pumping, filtration, centrifuges, atomisers and jointings and fittings.

The claim that it is 'a detailed survey of all the current data on fluid handling for chemical and water engineers' may be a little exaggerated. There is a great deal of information in this book, however, particularly in respect of equipment used for fluid handling.

It might be argued that if the drying of gases and filtration come under the heading of fluid handling, then distillation, liquid-liquid extraction and other operations involving fluids might similarly be classified. One minor criticism is the use of density instead of specific weight in the section on metering of liquids. These points do not detract from the usefulness of the book, and many chemical engineers and students of chemical engineering will find it of service. —E.J.C.

DEGRADATION OF VINYL POLYMERS. By H. H. G. Jellinek. Academic Press Inc., New York; Academic Books Ltd., London. 1955. Pp. 329. $8.50.

A great deal of literature has been published on methods of polymerisation of vinyl polymers. Although a considerable amount of academic work has been performed by Grassie, Melville and Jellinek on the degradation of polymers, comparatively little has been done in producing what the author describes as a 'comprehensive and critical survey.'

This volume starts with a lengthy 60-page chapter on formal mathematical theories of degradation. This is lucidly introduced through the ideas of average molecular weights and distribution functions. The two principle theories, those which are based on

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random initiation of degradation, and those depending on initiation at chain ends, are considered at length.

Further chapters deal with bulk degradation *in vacuo* and in solution, oxidative degradation, mechanical and ultrasonic degradation, with an appendix dealing with more recent work (mainly published in 1953 and 1954) which includes the use of high energy radiation. In the latter is included a table giving (inevitably perhaps, these days) the effect of atomic pile radiation on a number of polymers. Incidentally, this increases viscosity of some solutions of bromine containing polymers.

If a criticism of this book could be made, it is that there is no clearly defined summary anywhere of the latest state of knowledge without the use of excess mathematics except for a few pages which summarise the results on bulk degradation *in vacuo* for a number of polymers.

More on the applied side is a summary of published work on hydrolysis of polyvinyl acetate. Equally effects of oxidation and the effect of excess catalyst in reducing molecular weights are important technically, as is the question of molecular weight of, *inter alia*, natural rubber by mastication. The highly complex theories in respect of ultrasonic action are dealt with at length.

This volume is a most valuable addition to the library of the polymer chemist from the point of view of the information which it contains on a highly specialised subject. Whether it will help him to understand the mechanisms of polymer breakdown more clearly is a little more open to question, unless he is willing to make a cover-to-cover study of the complex kinetics of depolymerisation.—H. WARSON.

INORGANIC QUALITATIVE ANALYSIS SEMI-MICRO METHODS. By H. Holness. Sir Isaac Pitman & Sons Ltd., London. 1954. Pp. 150. 12s. 6d.

The question of whether a student should learn qualitative analysis by the semi-micro or by the classical method is still being debated, although there is no doubt that the former technique is becoming more widely adopted. It has the advantages of economy in bench space and stock reagents and is

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more rapid than the conventional technique, but the need for specialised apparatus presents a drawback. The strongest factor promoting its universal adoption would be the manufacture of a really cheap, robust and efficient centrifuge. Whatever the final outcome the present book is an excellent introduction to the technique and can be recommended as a practical book for all students up to General Degree standard.

The main scheme of analysis will be familiar to most, but certain modifications have been made. Group I on the classical scheme has been eliminated, the mercurous, lead and silver chlorides being taken into solution in a mixture of concentrated hydrochloric acid and bromine water in the hot. Silver is then included in the Group IIA separation, being precipitated from ammoniacal solution as the iodide. Cadmium is detected in the presence of copper by reducing the latter and traces of other Group II metals remaining in solution with sodium hydrosulphite. This procedure prevents the discoloration of the yellow cadmium sulphide with other black metallic sulphides.

Other introductions by the author include the separation of Group IIA and IIB metals by the use of a one per cent solution of lithium hydroxide containing potassium nitrate, and the identification of tin as its tannin complex. There is also a more elaborate routine for removing all interfering acid radicals from solution before the precipitation of Group III metals.

The text contains detailed experimental explanations of the effects of all the reagents used on the metallic ions in solution, but no attempt is made to link these phenomena with theoretical concepts. The scheme for the separation of acid radicals is largely conventional as are the detailed procedures for the separation of difficult mixtures of acid radicals. The book ends with some brief advice to the student and an outline course for the teacher.—J. R. MAJER.

A COMPANION TO PHYSICAL & INORGANIC CHEMISTRY. By R. W. Stott. Longmans, Green & Co. Ltd., London. 1955. Pp. ix + 184. 9s.

This book is intended to fulfil two requirements. The author feels that text books on elementary physical chemistry omit valuable qualitative discussion which, if included, would lead to a better understanding of principles. In the first part of the book an attempt is made to provide such discussion. The second part is intended to provide GCE and University scholarship candidates and first year university students with a framework on which to hang the large number of facts of inorganic chemistry which must be learnt and to show relationships between them. It is assumed that the reader has access to more orthodox text books and because of this many topics are omitted and examples and questions are not included.

The physico-chemical topics discussed in the first part are the ionic theory, vapour pressure and related phenomena, water, electrode and equilibrium potentials and chemical equilibrium. Much of the material included under the first two of these headings is to be found in orthodox text books and explanations do not always seem to be clearer or more detailed. A short chapter on physical and chemical properties of water is useful and serves to draw attention to its remarkable properties in relation to other solvents. Another dealing with electrode potentials, includes a clear discussion of such potentials, deductions from them and some useful applications to problems in electrolysis. There are useful sections on limitations of the collision theory, solubility products and applications of mass action in relation to qualitative analysis. The use of probability curves in discussion is a feature of the first part of the book.

In the second part the more important elements are considered in terms of their electrode potentials, properties of oxides, hydrides and chlorides and formation of complex ions. These properties are first used as a basis for classification as metals or non-metals. Groups 1, 7 and 2 are discussed briefly and aluminium in more detail. Carbon, silicon, tin and lead are discussed as a group and nitrogen, phosphorus, antimony and bismuth are considered similarly. The book concludes with a chapter on the transition elements, chromium, manganese and iron. Many up-to-date uses of the elements and of their more important compounds are given. The tables and summaries provided should be useful for revision.

While the author's aims seem, to some extent, to be fulfilled, the need for such a book may perhaps be rather limited. More detailed interpretation and co-ordination of

facts would seem to be the function of the teacher or lecturer at school or university. The discriminating student will, however, find useful material and the book should be of value for revision.—W. R. MOORE.

ANNUAL REVIEW OF PHYSICAL CHEMISTRY. Vol. 5. Ann. Reviews Inc., Stamford, California. 1954. Pp. ix + 540. $7.00.

This volume of the 'Annual Review' retains the basic topics of the previous volumes. In addition, there are some new topics and some revision in the method of treatment of the older ones. A review of the subject of cryogenics (low temperature physics) is presented for the first time, and an entire chapter is devoted to nuclear magnetic resonance phenomena in which there is great active interest at present. Furthermore, the subject of chemical kinetics, formerly covered in a single chapter, has been expanded into two, one on reactions in solution and the other on those in the gas phase. Photochemical advances are also covered in these latter two chapters.

The following chapter headings best indicate the scope of the present review:—Thermochemistry and the Thermodynamic Properties of Substances (L. E. Steiner); Heterogeneous Equilibria and Phase Diagrams (W. A. Gale); Solutions of Electrolytes (H. S. Frank and M. S. Tsao); Solutions of Non-Electrolytes (J. C. Morrow and O. K. Rice); Isotopes (W. M. Jones); Radioactivity and Nuclear Structure (I. Perlman and J. M. Hollander); Radiation Chemistry (E. J. Hart); Theory of Molecular Structure and Spectra (A. D. Walsh); Spectroscopy (A. B. F. Duncan); The Solid State (R. H. Bube, F. Herman and H. W. Leverenz); Kinetics of Reactions in Solution (F. A. Long); Kinetics of Reactions in Gases (J. C. Robb); Properties of Macromolecules in Solution (F. T. Wall and L. A. Hiller); Colloid Chemistry (S. A. Troelstra); Cryogenics (E. A. Long and L. Meyer); Nuclear Magnetic Resonance (H. S. Gutowsky); Crystallography (E. G. Cox); Surface Chemistry and Catalysis (G. Jura); Microwave Spectra of Gases (R. J. Myers and W. D. Gwinn); Experimental Molecular Structure (R. L. Livingston); Ion Exchange (J. Schubert); Statistical Mechanics of Transport and Non-Equilibrium Processes (E. W. Montroll and M. S. Green); Modern Aspects of Electrode Kinetics (J. O'M. Bockris). The names of the authors underline the authoritative nature of the reviews in each instance.

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It is clear that the 'Annual Review of Physical Chemistry' has now become firmly established. No active school of physical chemistry can afford to omit it from its library. It is as thoroughly documented with original literature references as ever. There are no serious misprints.—H. MACKLE.

MICRO AND SEMIMCRO METHODS. By N. D. Cheronis. Interscience Publishers, New York and London. 1954. Pp. xxiv + 628. $12.00.

This is volume VI of Weissberger's excellent series on 'Techniques of Organic Chemistry.' It is quite unusual in its field in that it stresses preparative work rather than analytical work. So often microchemistry is thought of solely in terms of analytical processes, and this should form a salutary corrective to that mistaken point of view.

The first one-third of the book deals with general preparative methods such as crystallisation, distillation, sublimation and extraction, and with the measurement of physical constants. The middle one-third describes preparative reactions under standard headings such as oxidation, diazotisation and esterification. A section by A. R. Ronzio deals with the specialised topic of microsyntheses with tracer elements. Part III of the book first describes preliminary tests and methods for the detection of elements. The tests for functional groups then follow. After this, about 100 pages are devoted to the important topic of the preparation of derivatives. This portion of the book is effectively an extension of the material described earlier under synthetic methods. Finally, written in conjunction with T. S. Ma, there is a short section on quantitative analysis which, starting from the premise that elementary analysis on the small scale is already adequately covered by specialised textbooks, deals only with the determination of functional groups.

The book maintains the high standard of the other members of the series already published, and it fills a gap in microchemical literature in the English language which has not hitherto been properly recognised. Workers in organic laboratories will find here much of value, and will refer to the book again and again. Students of chemis-

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try could hardly be introduced to a selection of the methods too early in their careers.

The choice of author is to be commended, for Professor Cheronis has for long been noted for his work in popularising small-scale methods in organic chemistry. This is an essential reference work in any organic laboratory, and, indeed, since the preparative methods of organic and inorganic chemistry are often similar, it is a book which should also prove of considerable interest to the inorganic chemist who is compelled to handle small amounts of material.—CECIL L. WILSON.

CHEMISORPTION. By B. M. W. Trapnell. Butterworths Scientific Publications, London. 1955. Pp. 265. 35s.

This book is an account of advances which have taken place recently in our understanding of the phenomenon of chemisorption, a field in which the author himself has made many useful contributions.

In chemisorption, the adsorbate undergoes a chemical reaction with the surface layer and is itself dissociated into independent fragments. Much more is now known of the nature of the chemical bonds formed at the surface and of the surface radicals in the chemisorbed layer. In the case of the transition metals, for example, it is now clear that chemisorption involves covalent linkages which utilise orbitals in the metal electronic d-band. Direct experimental evidence for this type of binding has been obtained in some cases by measurement of the decrease in magnetic susceptibility which follows adsorption, but the most convincing argument for the theory lies in the detailed examination of the activity of a wide range of metal films which has shown that chemisorption of the common gases such as N_2, H_2, Co and C_2H_4 is, with a few exceptions, confined to metals with partly filled d-bands.

The close relationship between chemisorption and heterogeneous catalysis suggests a possible connection between the electronic structure of the metal and its catalytic activity and several investigators have sought proof of such a relation. It is certainly true that high catalytic activity is associated with the transition metals but since the d-band character of the metal controls the lattice spacing in the surface it is not clear in every case whether the electronic structure controls the catalytic activity directly, or indirectly by affecting the geometrical spacing of the metal atoms in the surface layer.

The author discusses these and many other aspects of chemisorption with an enthusiasm for his subject which is born, no doubt, from his close personal connection with the work which he describes. His enthusiasm is infectious and this book will be read with profit and pleasure by any chemist who wishes to keep abreast with the important progress which has been made in this field. As an introduction to his text the author provides a brief but lucid account of the experimental methods which have been employed in studying chemisorption. There are many well chosen diagrams which add to the reader's ease of understanding and the book is well produced. Altogether it can be recommended with confidence.—R. C. PINK.

MICHAEL FARADAY. By J. Kendall. Faber & Faber, London. 1955. Pp. 196. 12s. 6d.

This is a short popular biography of Faraday, largely concerned with his life at The Royal Institution, and simple in its treatment, both of his character and his scientific achievements. It is written in a light amusing manner and should present no difficulties to the non-scientific reader. There are many quotations from Faraday's original manuscripts and several of his original sketches are reproduced. The accent is placed upon the contributions which he made to the subject of electromagnetism rather than upon his less spectacular chemical discoveries, but mention is made of his identification of benzene and his work on steel alloys.

A good deal of space is devoted to the discussion of the early controversies over the liquefaction of chlorine and the discovery of the 'first electric motor.' The origin of these new discoveries is an unimportant factor in our estimation of Faraday as a scientist and it may be felt that his case is overstressed, for whatever contribution his experimental skill made to these discoveries there is no doubt that both were prompted by Davy and Wollaston. This is however largely a matter of personal opinion and we should feel indebted to Professor Kendall for providing us with such a readable study in which many generations of young scientists may find inspiration.—J. R. MAJER.

HOME

ECGD Office in Newcastle

The Export Credits Guarantee Department have opened a new branch office in Newcastle to service exporters in the Tyneside, Wearside and Tees-side areas. The address is ECGD, District Bank Chambers, Mosley Street, Newcastle-on-Tyne (Tel.: Newcastle 29838/9).

Forthcoming Conference

The 1955 annual conference of the Education Group of the Institute of Physics will take place on 14 and 15 April at the Institute's house, 47 Belgrave Square, London.

Bid to End Hydrocarbon Oils Duty

A deputation from the Industrial Light Oils Committee, representing 16 trade associations, visited Mr. R. Maudling, Economic Secretary to the Treasury, on 9 March to request the removal of the duty on light hydrocarbon oils used for industrial processes. Mr. Norman Campbell, director of the National Paint Federation and chairman of the committee, submitted the case for the repeal of the duty.

Drilling in Lincolnshire

Following geological and geophysical surveys of the area, a test well is being drilled at Ruskington, near Sleaford, Lincolnshire, by BP's D'Arcy Exploration Company. This is the first test well to be drilled in the area. It has so far reached a depth of more than 300 feet. At Chaldon Herring, Dorset, where D'Arcy recently completed an exploratory test well, a second shallow well is being drilled to obtain more geological information.

Chemical Engineering Research

Mr. F. Willey (Lab., Sunderland North) asked the Parliamentary Secretary to the Ministry of Works recently what action had been taken to implement the recommendations of the Report of the Committee on Chemical Engineering Research. Mr. J. R. Bevins, in a written reply, said that representative industrial bodies had been consulted and had made a detailed survey of the information and resources available in industry. The survey was now complete, and it was hoped that the trade associations would soon put forward definite proposals.

Supply of Epikote Resins

Albright & Wilson Ltd., 49 Park Lane, London W.1, announce that by arrangement with Shell Chemicals Ltd. they are now in a position to supply Epikote resins to PVC stabiliser users. These resins will be distributed under Albright & Wilson's own trade names and will include both the resins in unmodified form and formulated compositions based on them. Further details may be obtained on application to the Organic Chemicals Division of Albright & Wilson.

Plastics Exhibition for Birmingham

An exhibition of Bakelite, Vybak and Warerite plastics will be held at the Chamber of Commerce Assembly Hall, 95 New Street, Birmingham, from 28 March to 2 April. The exhibition is designed to be of interest both to the public and the technologist. It demonstrates the different ways in which the plastics are developed from their basic resinous state and their wide range of industrial applications.

£10,000 Damage in Tar Blaze

The Lime Wharf chemical works, Camelon, of Scottish Tar Distillers Ltd. were involved in a serious fire recently when a crude tar container caught fire and set alight two adjacent containers. Firemen from three counties fought to stop the blaze extending to nine other tanks. According to Mr. F. Potter, technical director of Scottish Tar Distillers, damage amounted to some £10,000. About 90,000 gallons of tar were lost. Stocks of benzole on the other side of the plant were not affected.

Symposium on Law & Management

The annual symposium of the Graduates and Students' Section of the Institution of Chemical Engineers is to be held on 15 April at Birmingham University. The papers which will be presented under the general title 'Law and Management for the Chemical Engineer', will deal with industrial law, safety and welfare, trades unions and personnel management. The symposium is open to all, the registration fee being 2s. 6d. for section members and 7s. 6d. for corporate members and visitors. The annual dinner dance will be held on the following evening at the Guild of Undergraduates Union, Edgbaston. Tickets are 21s. each.

• OVERSEAS •

Laboratory Equipment on Show

A special display of laboratory equipment for science and industry will be a feature of the Ninth International Fair at Ghent, Belgium, from 10 to 25 September. The exhibit, which may be repeated every five years, will be set up with the co-operation of the Belgian Chemical Society and will have as its theme 'The Laboratory at the Service of Humanity'.

British Isotopes Exhibition in Belgrade

An exhibition illustrating the use of isotopes in British medical research and treatment and in industrial and agricultural research has opened in Belgrade. Prepared by the British Atomic Research Institute, the exhibition was arranged by the British Council, the Yugoslav Commission for Cultural Relations with Foreign Countries, and the Technological Faculty of Belgrade University.

Plastics Fair in USA

Displays at the World Plastics Fair and Trade Exposition to be held at Los Angeles, California, from 6 to 10 April will be based on the theme 'better living made possible by plastics.' Exhibitors will include manufacturers of the basic raw materials, machinery, equipment and tools used by the plastics industry, as well as makers of plastics products.

Nuclear Reactor for Chicago

A nuclear reactor is to be built in Chicago this year specifically for private industrial research. Various private industrial firms will co-operate with the Armour Research Foundation of the Illinois Institute of Technology in financing the project, which will cost $500,000.

Demand for Copper in Australia

Present Australian demand for copper is at the rate of 60,000 tons a year and is 20,000 tons in excess of Australian production, the chairman of Mount Lyell Mining and Railway Co. Ltd., Mr. W. Bassett, told shareholders at the annual meeting of the company in Melbourne recently. Mr. Bassett said that indications were that Australia would continue to require more copper than could be produced locally, and that prices would remain satisfactory.

New Swedish Bleaching Plant

Construction began some months ago of a new bleaching plant at the Muksjo Company's sulphate mill in Aspa Bruk, Sweden. The plant, which will use chlorine dioxide as one of its bleaching agents, will produce 100 tons a day of bleached kraft, mostly for export.

Contract for US Refinery

The first of several multi-million dollar construction contracts for the American Oil Company's new 35,000 barrel-per-day refinery to be built near Yorktown, Va., has been awarded to The M. W. Kellogg Company of New York City. The complete refinery is scheduled for completion by late 1956. This initial general construction contract provides for two major refining process units, three buildings and all electrical and pipeline facilities for the refinery on the 1,200-acre site along the York River.

Merger for Uranium Development

A big merger of uranium interests to explore and develop the Mary Kathleen uranium field at Mount Isa, in Queensland, has been announced in Brisbane. A major British mining company, Rio Tinto, has concluded an agreement under which it will assume the direction and the financing of the exploration programme at the Mary Kathleen field.

Rise in US Sulphur Output

United States' output of sulphur rose during 1954 to 5,515,543 long tons (native) and 357,400 tons (recovered), according to the US Bureau of Mines. This was an increase of 7 per cent and 6 per cent respectively over the figures for the previous year. In December, production was 477,909 long tons of native sulphur and about 32,200 long tons of recovered sulphur.

Canadian Exports Rise

Although exports as a whole were down by 6 per cent, exports of Canadian chemicals rose by 17 per cent during 1954, the biggest gain made by any product group in the country. The improvement has continued this year, and if the present tempo is maintained chemical exports this year should come close to topping $200,000,000.

· PERSONAL ·

On 7 June the University of Cambridge will confer the honorary degree of D.Sc. upon SIR CYRIL HINSHELWOOD, M.A., D.Sc. (Oxon.), Hon. Sc.D. (Dublin), Hon. D.Sc. (Lond. & Leeds), F.R.I.C., F.R.S., Dr. Lee's Professor of Chemistry in the University of Oxford.

MR. K. W. PALMER has been appointed a director and president of I.C.I. (New York). He succeeds MR. R. T. HOLDER. Mr. Palmer has been on the chairman's staff in London since 1953, and before that he was a member of the Dyestuffs Division.

MR. FRANCIS L. WARING has been appointed managing director of Coalite and Chemical Products Ltd. and its subsidiaries. SIR CYRIL F. ENTWISTLE, who is already a director of the parent company, has joined the boards of the subsidiaries.

SIR EDWARD BULLARD, M.A., Sc.D., F.R.S., is to resign from the directorship of the National Physical Laboratory, which he has held since 1950. He has been awarded a fellowship of Caius College, Cambridge, and will return to the University to continue his researches in geophysics. No date for the move has yet been given, or a successor named.

The administrators of the Sir George Beilby Memorial Fund, representing the Institute of Metals, the Royal Institute of Chemistry and the Society of Chemical Industry, have made awards from the fund for 1954, each of 150 guineas, to: H. K. HARDY, M.Sc., Ph.D., A.R.S.M., in recognition of his work in physical metallurgy, with special reference to precipitation hardening and to the thermodynamics of phase equilibria in alloy systems; and J. W. MENTER, M.A., Ph.D., A.Inst.P., in recognition of his work on surface phenomena, with special reference to the application of electron optical techniques to the elucidation of a wide range of problems. Awards from the fund are made to British investigators in science as a mark of appreciation of distinguished work, particularly in such fields as fuel economy, chemical engineering and metallurgy in which Sir George Beilby's special interests lay. In general, the awards are not applicable to more senior investigators but are granted as an encouragement to relatively young men who have done independent work of exceptional merit over a period of years. Dr. Hardy joined Fulmer Research Institute in 1946 as Head of the Physical Metallurgy Section and was later appointed senior metallurgist. Dr. Menter recently joined the Tube Investments Research Laboratories, Hinxton Hall, where he leads a group working on surface phenomena.

PROFESSOR ALEXANDER ROBERTSON, F.R.S., Heath Harrison Professor of Organic Chemistry at Liverpool University, is one of six new members appointed to the University Grants Committee. He was appointed to the Chair of Organic Chemistry in 1933 when he was 37. He is a Scot and graduated at Aberdeen and Glasgow Universities. As a Rockefeller International Science Fellow he did research work at Manchester University and later went to Graz University, Austria. He was made a member of the Royal Society in 1941.

MR. W. T. WINTERBOTTOM, C.B.E., of Heybridge House, Heybridge Lane, Prestbury, Cheshire, one of the best known figures in the industry, has accepted an invitation from the Textile Institute to be nominated as its next president, in succession to Mr. C. H. Colton. Mr. Winterbottom, chairman of Fine Spinners and Doublers Ltd., and a director of the Moorfield Spinning Co. Ltd., Paul Catterall Ltd., and John Gregory (Mirfield) Ltd., already holds many important positions in the industry. He is president of the Federation of Master Cotton Spinners' Associations, chairman of the Rayon Staple Spinners & Doublers Association, and a member of the Cotton Board and of the British Productivity Council. Mr. Winterbottom, a member of the Institute since 1946, will be nominated for election at the Institute's 45th annual meeting, to be held at Bolton Town Hall on Wednesday, 27 April. The Institute's council has nominated MR. ALLAN DRAPER, F.T.I., PROFESSOR E. HONEGGER, D.Sc., F.T.I., and MR. J. A. NASMITH, B.Sc. Tech., Assoc. I.Mech.E., A.M.C.T., for election as vice-presidents at the same meeting. The meet-

ing will be followed by the annual Mather Lecture, to be given by MR. H. JACKSON, joint managing director of I.C.I. Ltd. (Dyestuffs Division), whose subject will be 'The Inter-relationship of the Chemical and Textile Industries.'

The following appointments at the research and development laboratories at Sully, near Penarth, Glamorgan, are announced by British Resin Products Ltd.: DR. E. M. EVANS, B.Sc., Ph.D.(Lond.), A.R.C.S., D.I.C., F.R.I.C., to be manager of the laboratories; MR. J. H. W. TURNER, A.R.I.C., to be manager of the technical service division; MR. A. G. CATT-CAMFIELD to be manager of the research division.

Among new Fellows of the Royal Society, elected recently, is DR. WILLIAM AIRD PEDEN BLACK, B.Sc., Ph.D.(Edin.), F.R.I.C., head of the chemical division at the Institute of Seaweed Research, Musselburgh.

Because he has been given medical advice to take a few weeks' rest, DR. P. HAAS, Ph.D., D.Sc., will not receive the Hinchley Medal of the British Association of Chemists on the date planned, 25 March. A new day for the presentation has not yet been arranged.

LORD BENNETT of Edgbaston, joint managing director of Joseph Lucas Ltd., and Parliamentary Secretary to the Minister of Labour from 1951-52, who was the first chairman of the British Productivity Council, has accepted an invitation to be its first president. Among the five vice-presidents of the council will be SIR GRAHAM HAYMAN, Kt., deputy president of the Federation of British Industries and vice-chairman of the Association of British Chemical Manufacturers.

Appointment of W. P. WALKER, O.B.E., as vice-president and treasurer of Canadian Chemical & Cellulose Co. Ltd., to become effective in April, has been announced by M. W. Mackenzie, president. Mr. Walker replaces J. H. BLACK who is returning to Celanese Corporation of America as secretary of its finance committee.

MR. RICHARD JONES, a native of Waenfawr, Caernarvonshire, who has accepted a call to be pastor of Hyfrydle Calvinistic Methodist Church, Holyhead, was a research chemist and lecturer before entering Mansfield College, Oxford, as a divinity student last year. Mr. Jones graduated B.Sc. with honours at the University College of North Wales, Bangor, in 1939, and was subsequently a research chemist at Derby and Ellesmere Port. At one time he was a lecturer at Liverpool Technical College and in 1952 became a lecturer at Cardiff Technical College. Last year he entered Mansfield College, where he is completing his course for the B.A. degree.

MR. JOHN A. ACKLEY has been appointed secretary-treasurer of Pyrofax Gas Corporation, a unit of Union Carbide & Carbon Corporation. He was also appointed secretary-treasurer of Pyrofax Gas Ltd., the Canadian subsidiary of Pyrofax. Mr. Ackley succeeded MR. FRED L. SHANKLIN who becomes manager of administration of the Ore Division for Union Carbide.

MR. TOM R. RAGLAND has been named vice-president of Union Carbide International Company and will be responsible for the direction of the chemicals and plastics departments of the company. This division of Union Carbide and Carbon Corporation handles export sales and overseas production operations.

Obituary

The sudden death occurred on 11 March of SIR ALEXANDER FLEMING, Kt., M.B., B.S. (Lond.), F.R.S., F.R.C.S. (Eng.), F.R.C.P., famous for his discovery of penicillin. He was 73. A native of Ayrshire, Sir Alexander joined the bacteriological department of St. Mary's Hospital, London, after a series of prize-winning successes as a medical student and stayed there throughout his life, apart from service in the RAMC in the 1914-18 war. He was Professor at the hospital from 1928 to 1948. After his discovery of penicillin in 1928 attempts were made to extract it for medical use, but they were unsuccessful, and investigations virtually lapsed until 1938, when Sir Howard Florey and Dr. E. Chain solved the practical difficulties of preparation. In 1947 the Department of Inoculation at St. Mary's Hospital, where he had carried on bacteriological research under Almoth Wright, was renamed the Wright-Fleming Institute of Microbiology and placed under his direction. Sir Alexander Fleming was knighted in 1944. With Sir Howard Florey and Dr. Chain, he shared the Nobel Prize for Medicine in 1945 and he received many honours from universities in Europe and America.

Next Week's Events

MONDAY 21 MARCH

Royal Society of Arts

London: John Adam Street, Adelphi, W.C.2, 6 p.m. Second of three Cantor lectures on 'The Mechanical Properties of Metals': 'Creep' by Professor E. N. da C. Andrade.

SCI (London Section)

London: Lecture Theatre, Institution of Mechanical Engineers, 1 Birdcage Walk, S.W.1, 6.30 p.m. A programme of scientific films.

SCI (Agriculture & Pesticides Groups)

London: Chemical Society's rooms, Burlington House, Piccadilly, 5.30 p.m. 'The Crop Protection Products Approval Scheme: Part III.'

SCI (Yorkshire Section)

Leeds: Chemistry Lecture Theatre, The University, 7 p.m. Annual general meeting and presentation of short papers by members.

Institution of the Rubber Industry

Manchester: The Engineers' Club, Albert Square, 6.45 p.m. 'Ozone Resistance of Butyl Vulcanisates' by J. Walker.

Institute of Metal Finishing

London: Northampton Polytechnic, St. John Street, E.C.1, 6.15 p.m. 'Electrodeposition of Aluminium' by R. J. Heritage.

TUESDAY 22 MARCH

Institute of Fuel

Stoke-on-Trent: MEB Lecture Hall, Kingsway, 7 p.m. 'Advances in Complete Gasification' by Dr. F. J. Dent.

Institute of Metal Finishing

Birmingham: Regent House, St. Phillips Place, Colmore Row, 6.30 p.m. Organic Finishing Group meeting: 'Aircraft Finishes' by S. G. Anderson.

WEDNESDAY 23 MARCH

Chemical Society

Dublin: Chemistry Department, University College, 7.45 p.m. 'Recent Advances in Acetylene Chemistry' by Professor R. A. Raphael.

SCI (Nutrition Panel & Oil & Fats Group)

London: Chemical Society's Rooms Burlington House, Piccadilly, 6.30 p.m. 'Some Aspects of Fat Metabolism with Special Reference to the Biosynthesis of Milk Fat' by Dr. S. J. Folley (preceded by Nutrition Panel AGM).

SCI (London Section)

Southampton: Conference Room, Civic Centre, 7.30 p.m. 'Lube-Oil Additives' by G. W. Hayward (joint meeting with RIC and Institute of Petroleum).

Institution of Chemical Engineers

Huddersfield: Technical College, 7 p.m. 'The Separation of Organic Mixtures by Solidification from the Melt' by J. S. Forsyth and J. Wood.

Institution of Chemical Engineers

Birmingham: The University, Edmund Street, 6.30 p.m. Graduates and Students' Section: annual meeting of Midlands Centre, followed by 'The Role of the Student Section in the Training of the Chemical Engineer' by Professor F. Morton.

THURSDAY 24 MARCH

Institute of Fuel

London: Institution of Civil Engineers, Great George Street, S.W.1, 5.30 p.m. Two papers by W. F. B. Shaw and J. W. McHugo on the development and use of the calorimeter at the Fuel Research Station, Greenwich.

Institute of Physics

London: 47 Belgrave Square, S.W.1, 6.30 p.m. 'Recent Developments in Ultrasonics' by Dr. E. G. Richardson.

FRIDAY 25 MARCH

SCI (Chemical Engineering Group)

Cardiff: University College, Cardiff, 7 p.m. 'Chemical Engineering Developments in the Coal Industry' by G. I. Jenkins (joint meeting with South Wales Section).

Institute of Metal Finishing

Sheffield: Grand Hotel, 6.30 p.m. 'A Review of Methods of Effluent Disposal' by F. Wild.

Society of Instrument Technology

Glasgow: Natural Philosophy Department, Royal Technical College, 7 p.m. 'Measuring Lags and Static Errors of Sheath Protected Temperature Detecting Elements' by A. Morrison.

SATURDAY 26 MARCH

Royal Institute of Chemistry

Reading: The University, 2.30 p.m. Symposium on 'Chemical Aspects of Semiconductors'.

Law & Company News

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Mortgages & Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary but such total may have been reduced.)

H. LEVINE (PLASTICS) LTD., Manchester.—3 February, series of £10,000 debentures, present issue £6,000; general charge.

NUTFIELD MANUFACTURING CO. LTD., South Nutfield, chemical manufacturers.—8 February, mortgage, to Midland Bank Ltd. securing all moneys due or to become due to the bank; charged on King's Mill Works, Kingscross Lane and 1 & 2 Brickfield Cottages, Nutfield, with fixtures. 29 June, 1951.

Increases in Capital

The following increases in capital have been announced: BRITISH CHROME & CHEMICALS LTD., from £100 to £810,000; PLASTIC CONSTRUCTIONS LTD., from £1,000 to £5,000; BROOKES CRYSTALS LTD., from £3,000 to £5,000; CYANAMID PRODUCTS LTD., from £20,000 to £700,000; LANKRO CHEMICALS LTD., from £25,000 to £125,000; KILL-GERM CO. LTD., from £10,000 to £50,000; GIVAUDAN & CO. LTD., from £250,000 to £300,000; WM. BUTLER & CO. (BRISTOL) LTD., from £375,000 to £650,000.

Company News

Thos. W. Ward Ltd.

An interim dividend of 3¾ per cent has been declared by Thos. W. Ward Ltd., comparing with an equivalent of 2½ per cent interim payment last year.

British Celanese Ltd.

British Celanese Ltd. has acquired practically the whole of the ordinary share capital in and control of Natal Textiles, which owns Silknit, the largest knitting plant in South Africa. Fabrics will be manufactured in Durban from acetate and nylon yarns and also from the company's new Tricel triacetate yarn.

Bakelite Ltd.

Preliminary figures show that group profits of Bakelite Ltd. for 1954 were £320,702, after allowing for taxation and other charges, compared with £252,749 in the previous year. A final dividend of 11 per cent (9½ per cent) is recommended, making with the increased interim of 5 per cent a total payment of 16 per cent (12½ per cent).

Hilger & Watts Ltd.

Net group profit of Hilger & Watts Ltd. and subsidiary companies for the year ended 30 September, 1954, was £99,799, compared with £73,388. After taxation net group profit was £41,494 (£29,178). An ordinary dividend of 9 per cent, against last year's 7½ per cent, is recommended to the annual meeting on 24 March.

Negretti & Zambra Ltd.

Turnover of Negretti & Zambra Ltd. last year was £1,182,543, compared with £1,065,440 previously, the chairman, Mr. P. A. Negretti, said at the annual general meeting on 8 March. Trading profit rose from £275,336 to £288,282. Mr. Negretti said that although the value of orders received since 30 September was appreciably greater than in the corresponding period of the previous year, increased costs made it difficult to forecast the future. However, he added, 'I see no reason why we should not look forward to another satisfactory year.'

Jeyes' Sanitary Compounds Ltd.

Jeyes' Sanitary Compounds Ltd. having contracted to acquire the Ibbetson group of companies, manufacturers of Ibcol, Sanilav, Airzone, Miraglo, etc., an issue of 600,000 ordinary shares of 5s. each at 12s. 6d. a share is being made to the public.

Celanese Corporation of America

The directors of Celanese Corporation of America have declared a dividend of 12½ cents a share on the common stock, payable on 24 March to holders of record on 7 March. The board also voted regular quarterly dividends of $1.12½ on the 4½ per cent preferred stock, series A, and $1.75 on the 7 per cent second preferred stock. Both

(continued on page 706

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dm HP 2

Law & Company News

continued from page 704

preferred stock dividends are payable on 1 April to holders of record on 7 March.

Redfern's Rubber Works Ltd.

Major transformation and redeployment is envisaged in the annual review of the chairman of Redfern's Rubber Works Ltd., Mr. Thomas H. Redfern. It will involve further substantial capital spending beyond the £150,000 scheme now in progress. 'Our turnover last year was a new record in our history, but the departments are now increasingly cramping each other's expansion, and in view of technical developments we need to redeploy to increase our productivity further,' says the review.

International Nickel Company of Canada

New records were established in 1954 by The International Nickel Company of Canada Ltd. for net earnings, deliveries of nickel and ore mined. Net earnings for the company and its subsidiaries were $65,295,186 in terms of US currency. This compares with $53,694,526 in 1953 and $62,875,571 in 1951, the previous peak year. For the first time in the company's history more than 14,000,000 tons of ore were mined. The company operated at a peak production rate for the fifth successive year, carried forward its extensive programme of exploration for new nickel deposits, speeded construction on the first unit of its new plant for the recovery of iron ore from the pyrrhotite in its ores and achieved at its Port Colbore refinery the first commercial production of electrolytic cobalt in Canada.

American Potash & Chemical Corporation

A group comprising Lehman Brothers, Glore, Forgan & Co., William R. Staats & Co. and J. Barth & Co. is offering to the public $7,000,000 American Potash & Chemical Corporation 3½ per cent convertible subordinated debentures due 1 March, 1970. The debentures are priced at 101 per cent plus accrued interest, to yield 3.54 per cent. The company will apply $900,000 of the net proceeds to reduction of bank loans. The balance of the proceeds will be added to general funds of the company, to be used for general corporate purposes. Such purposes include payment for planned improvements to present plants and equipment estimated at $3,000,000; replenishment of working capital used in recent years for plant improvements and additions; and replenishment of working capital for investments made in Bikita Minerals (Private) Ltd. and American Lithium Chemicals Inc. Last year a 21.25 per cent stock interest was acquired in Bikita Minerals, which owns a large lithium-beryllium deposit in Africa. American Potash & Chemical organised American Lithium Chemicals Inc. in 1954 and holds 50.1 per cent of its common stock; the latter company will manufacture lithium chemicals in Texas.

Market Reports

LONDON.—A steady call against contracts for the chief consumer industries and a fair weight of new buying orders has been reported during the past week. Among the soda products, chlorate, dichromate and yellow prussiate are in good call, and the sulphides are firmer against a steady demand. Most of the potash chemicals continue firm and unchanged, and in the miscellaneous products hydrogen peroxide and formaldehyde are attracting attention. Some improvement in the demand for fertilisers has been reported, and a seasonal pressure for delivery has been in evidence. In the coal tar products market there is a steady movement in the light distillates and a persistent demand for creosote oil and crude and crystal carbolic acid. Quotations are unchanged with a firm undertone.

MANCHESTER.—Generally firm price conditions have been reported this week on the Manchester market for heavy chemicals. A wide range of products is being called for in fair quantities against contracts by the textile and allied industries, but short-time working at a number of Lancashire mills is a continued cause of anxiety. Other leading industrial consumers are taking steady deliveries and replacement business is coming forward satisfactorily. Taking the fertiliser market as a whole, business is now on a fair scale and a further seasonal improvement is looked for. Most of the tar products are meeting with a steady inquiry.

GLASGOW.—The market opened quietly, but steadily increased later on in the week with a good volume of orders being received. The demand for agricultural chemicals is now beginning to show a marked increase. Prices generally have remained steady. Numerous inquiries are still being received for export.

CLASSIFIED ADVERTISEMENTS

EDUCATIONAL

SALTERS' INSTITUTE OF INDUSTRIAL CHEMISTRY GRANTS-IN-AID

THE Committee will, in July, allocate a limited number of Grants-in-Aid to young men and women employed in Chemical Works in or near London, who desire to extend their education for a career in Chemical Industry. Applicants must not be under 17 years of age and must have Matriculation or its equivalent.

Applications should be made as soon as possible, whereupon forms will be issued requiring particulars of age, nature of employment and the manner in which the Grant would be used.

The application forms should be received, completed, before May 16th, 1955, by :—

THE CLERK OF THE SALTERS' COMPANY,
Salters' Institute of Industrial Chemistry,
36, Portland Place,
London, W.1.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive, or a woman aged* 18-59 *inclusive, unless he or she, or the employment, is excepted from the provisions of the Notifications of Vacancies Order,* 1952.

A VACANCY occurs on the editorial staff of **THE CHEMICAL AGE** for sub-editor-reporter. Experience of Industrial Chemistry desirable ; ability to write lucidly essential. Apply, in writing, giving full details of experience and salary expected, to the **MANAGING DIRECTOR, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4.**

APPLICATIONS are invited from **CHEMISTS** for a progressive position in a large industrial Research Laboratory, to study problems connected with the formulation and testing of detergent blends. Applicants should have a good degree or equivalent experience, preferably in the detergent and textile fields. Good salary commensurate with qualifications and experience. Apply **MANAGER, SALES SERVICE LABORATORY, LAPORTE CHEMICALS LIMITED, LUTON, BEDS**

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CHEMIST (Graduate), age 35 to 45, preferably with a higher degree, and interested in Physical Chemistry, is required by J. & G. Cox, Ltd., Glue and Gelatine Manufacturers, to act as assistant to the Technical Director. The candidate appointed will be expected to master the technical details of manufacture, and the scientific controls used in the industry. He will become responsible for controlling the process and the laboratory. Commencing salary will depend on age, qualifications and experience. Applications should be sent to the **TECHNICAL DIRECTOR, J. & G. COX, LTD., GORGIE MILLS, EDINBURGH, 11.**

THE Associated Ethyl Company Limited has vacancies for **CHEMICAL ENGINEERS.** The work is concerned with the development, co-ordination and commissioning of modifications and new engineering projects. Experience in chlorine would be an advantage for one of the posts.

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Applications, giving full details of the above, should be made to The Deputy Manager—Personnel, The Associated Ethyl Company Limited, Ellesmere Port, Cheshire.

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